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ExpORL

Let your hands do the talking

Key word signing in adults with intellectual disability

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Doctoral thesis in Biomedical Sciences

Leuven, 2014

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ISBN 978-90-9028698-3

Let your hands do the talking

for they
speak
louder
than words

Voorwoord

Ik ben er. Ik heb een berg beklommen. Ik beklom al wel eens vaker een berg, maar nog nooit eentje zo hoog, zo ver, zo zwaar, en zo uitdagend. Ik kreeg er dan ook nog nooit zo'n adembenemend uitzicht voor in de plaats. Ik ben nog wat ijl in mijn hoofd door het zuurstofgebrek hier op deze hoogte, maar toch dringt het langzaam tot me door: ik ben er!

Hier was ik natuurlijk nooit geraakt zonder jullie. Al kan ik niet volledig in woorden vatten wat een enorme hulp ik heb gekregen van zowel sympathisanten, supporters en sponsors als van sherpa's, medewandelaars en tochtgenoten die bijna helemaal mee gingen tot aan de top, toch ga ik een poging wagen.

Mijn grootste woord van dank is voor de twee vaste waarden die mijn tocht hielpen voorbereiden, uitvoeren en afronden: Inge en Bea. Ik kon altijd bij jullie terecht, zowel met inhoudelijke en praktische vragen, als voor enthousiast gesupporter, bemoedigende woorden en duwtjes in de rug. Jullie lieten me genoeg ruimte om mijn eigen weg te zoeken, maar gidsten me vakkundig verder wanneer ik die weg even kwijt was. Jullie zijn me meermaals uit het dal komen halen om me de weg richting de top weer te wijzen, en dat is jullie geweldig goed gelukt, een hele dikke merci daarvoor!

I would like to thank the members of the jury, prof. Juliet Goldbart, prof. Filip Loncke, prof. Eric Manders, prof. Katja Petry, and prof. Hans van Balkom, for your interest in the study, the work you put in reviewing the manuscript, your highly appreciated feedback and the effort you put into delivering this feedback timely to me, and for attending the public defence of this thesis.

Er waren heel wat mensen betrokken bij het voorbereiden en vormgeven van dit project. Allereerst wil ik Annemie Van Roy, DART in Göteborg, en de logopedisten en cliënten van Het GielsBos in Gierle, de Stichting Delacroix in Tienen, DVC Sint-Jozef in Antwerpen, en Borgerstein in Sint-Katelijne-Waver, bedanken om mij te laten kennismaken met en onderdompelen in de wereld van ondersteunde communicatie en SMOG bij personen met een verstandelijke beperking. De pedagogen en artsen van het Centrum voor Menselijke Erfelijkheid, prof. Liz Ward van the University of Queensland en prof. Ann Goeleven wil ik bedanken om mij te laten proeven van het wetenschappelijk onderzoek en mij het vertrouwen te geven dat ik dat misschien ook wel zou kunnen. Verder bedank ik een aantal, niet nader te noemen, artsen, die een cruciale rol speelden in het ontstaan van dit onderzoeksproject door het me op mijn eerste job als logopediste bijzonder moeilijk te maken. Dankzij hun opmerkingen zoals: “Hou jij je maar bezig met je kleurpotloodjes”, groeide in mij de vastberadenheid om mij te verdiepen in de rol die de logopedist kan spelen bij personen met een verstandelijke beperking, ontwikkelde ik het doorzettingsvermogen om mij vast te bijten in het domein van de ondersteunde communicatie, en besloot ik om mijn masterstudie aan de KU Leuven aan te vangen, zonder welke het woord “doctoraat” zelfs nooit in me zou zijn opgekomen. Het Steunfonds Marguerite-Marie Delacroix wil ik bedanken voor de financiële steun. Dirk, jij was bij het prille begin van deze tocht aanwezig.

Jouw expertise en kritische vragen hielpen me om mijn plannen te concretiseren. Ook leidde je me rond in de wondere AAC-wereld en zorgde ervoor dat mijn eerste ISAAC-congres een topper werd (ondanks een eerst vergeten en dan verscheurde poster…). Bedankt! De mensen van het VAPH, Gerda Geenen en Lies Peeters, wil ik bedanken om mij steeds snel en vriendelijk verder te helpen aan informatie. De audiovisuele dienst van de KU Leuven heeft me enorm geholpen bij het filmen en monteren van de meer dan 500 SMOG-filmpjes, merci! Bedankt aan Roger Verpoorten voor de uitleg in verband met het CPZ, en bedankt aan de pedagogen van het CME om mij hun test uit te lenen. Ik wil ook Ilse Noens en Jarymke Maljaars bedanken voor de ComVoor-training, en Veerle Algoed voor de hulp bij het zoeken naar een geschikte motorische test. Marleen Vanvuchelen wil ik heel hartelijk bedanken, niet alleen om mij in sneltempo op weg te zetten met de PIPS en om mij die PIPS dan ook uit te lenen, maar ook voor de vele zeer bruikbare tips en de aangename gesprekken. Bedankt ook aan Mieke Van Herreweghe voor de informatie in verband met de Vlaamse Gebarentaal en het delen van de Sign Language Studies databank. Een zeer speciale dankjewel verdienen de mensen van SMOG, en dan specifiek Rosie Roothans van Gezin en Handicap, Hilde Vangheluwe en Greet Martens bij wie ik de cursus volgde, Filip Loncke en Martine Nijs voor het geduldig beantwoorden van mijn talrijke vragen, en vooral SMOG-bezieler in hart en nieren Louis Smet, die jammer genoeg gestorven is tijdens het project, voor de interesse, en de vele gesprekken, telefoontjes en mails.

Key word signing is not only used in Flanders, and I have had the honour of meeting many international KWS colleagues during this project. Many thanks to Karen Bloomberg from KWS Australia, Marie-Gabriëlle Tytgat from Coghamo in Brussels, Andrea Hubbers from the Netherlands, Allmuth Bober from Germany, and the people from Makaton in England, Làmh in Ireland, and TAKK in Sweden, for their interest in the project and the valuable, interesting, and motivating conversations we have had.

Ook bedankt aan de grote bende inspirerende ondersteunde-communicatie-mensen die ik op mijn weg ben tegengekomen: de mensen van Modem, en speciaal Ruth dankzij wie het tweede ISAAC-congres een topper werd (ondanks het nogal chaotische en “water-en-zelfs-geen-droog-brood” concept), de mensen van ISAAC-NF, met wie ik het genoegen had een (heel kort) tijdje samen te werken, en de talrijke geïnteresseerde logopedisten, pedagogen, ouders en SMOG-gebruikers, die me regelmatig vroegen “hoe het nu zat met dat SMOG-project”.

Natuurlijk was dit project niets zonder de vele deelnemers. Ik wil alle studenten die meewerkten aan de transparantie- en translucentiestudies hartelijk bedanken. Ook bedankt aan de studenten van de KHLim, die enorm enthousiast deelnamen aan de SMOG-cursus. Een grote dankjewel aan alle Vlaamse voorzieningen voor volwassenen met een verstandelijke beperking: jullie hebben mij of één van mijn thesisstudenten allemaal aan de lijn gehad, en geduldig geantwoord op onze vragen. Een groot deel van deze voorzieningen spendeerde kostbare tijd aan het invullen van één of meerdere vragenlijsten. Heel hartelijk bedankt daarvoor! Ten slotte zijn er nog de voorzieningen bij wie ik mocht langskomen om de SMOGgers met eigen ogen aan het werk te zien. Een enorme dankjewel aan de pedagogen, logopedisten, begeleiders en natuurlijk de cliënten van deze voorzieningen. Jullie hebben me allemaal zo warm ontvangen, jullie enthousiasme vormde een enorme motivatie-boost en jullie ongedwongenheid en vrolijkheid bezorgen me nu nog regelmatig een glimlach op mijn gezicht. Ik heb echt genoten van de vele gesprekjes die ik met jullie mocht voeren. Jullie, lieve SMOGgers, waren de inspiratiebron voor dit onderzoek, en zonder jullie was er van dit onderzoek geen sprake geweest, dus echt een geweldige, dikke merci!

Bij het verzamelen, verwerken en op papier krijgen van deze schat aan informatie kon ik ook op de hulp van een aantal mensen rekenen. Bedankt aan alle thesisstudenten die hun steentje bijdroegen: merci Audrey, Berdien, Caroline, Charlotte, Elisa, Els, Evelyne, Helena, Inge, Isabelle, Kaat, Lisa, Marie, Marlies D., Marlies V., Sanne, Tine C., en Tine D., voor het vele en harde werk! Ook wil ik prof. Anne-Marie De Meyer bedanken voor de zeer gewaardeerde hulp bij de regressie-analyses.

Op mijn tocht kreeg ik ook heel wat logistieke ondersteuning, en was er regelmatig tijd voor deugddoende ontspanning. Een eerste grote dankjewel gaat naar Frieda, de rots in de ExpORL-branding. Zonder jouw hulp zou ik nog altijd niet weten wat met al die bestelbons en raamcontracten aan te vangen.

Wilfried wil ik bedanken voor de tips in verband met de belichting van mijn filmpjes, en mijn rug wil Wilfried bedanken voor de vakkundig op maat gemaakte blokken onder mijn bureau! Bedankt aan de huisvestigingsdienst van de Kulak om voor mij zo snel een kot in Kortrijk te regelen van waaruit ik de West-Vlaamse SMOGgers kon gaan testen. De koks van de deelnemende voorzieningen wil ik bedanken om mij regelmatig wat krachtvoer toe te stoppen. Merci ook aan het winkeltje van Gasthuisberg, om mij op eenzame, late werkavonden van energie te voorzien, glutenvrij en al! Uiteraard wil ik ook al mijn (ex-)collega's van op de berg bedanken. Zonder jullie had ik het niet gered! Bedankt voor alle ExpORL-fun, voor de wandelingen, sportieve uitspattingen, wijnproeverijen, spelletjesavonden, serieuze en minder serieuze meetings, voor de inspiratie, de babbels, oppeppende woorden en luisterende oren, voor het samen moppen tappen en schaterlachen. Ik ga jullie missen!

Natuurlijk wil ik ook mijn vrienden en familie bedanken voor hun steun tijdens deze pittige doctoraatsjaren. Ik was zelf niet altijd even bereikbaar, met mijn hoofd in de boeken, en toch kon ik altijd bij jullie terecht. Bedankt voor de leuke telefoontjes, mailtjes, dates, brunchkes, weekendjes, feestjes en uitstapjes. Aan wie de laatste tijd niet meer durfde vragen hoe het met dat doctoraat ging: nu hoeft het niet meer! 't Is af! Aan wie het wél nog durfde vragen: chapeau, want dat getuigt van grote moed! Vielen Dank auch an alle Kasseler, Kasselaner, und Kasseläner die sich regelmäßig um etwas Entspannung gekümmert haben.

Ten slotte wil ik nog een aantal mensen in het bijzonder bedanken. Mijn schoonouders verdienen een grote dankjewel voor de vele hulp en goede zorgen. Bedankt aan mijn (schoon)broers, (schoon)zussen, neefjes en nichtjes voor het enthousiaste gesupporter. Mijn zus, schoonbroer en schatten van neefjes Giel en Naud wil ik speciaal bedanken voor de heerlijke spelmomenten, de gezellige avondjes in Kessel-Lo en in Wommersom bij het vuur, en de intense en waardevolle gesprekken. Lieve moeke en pappie, jullie hebben mij enorm gesteund tijdens deze hele tocht. Ik wil jullie enorm hard bedanken voor de vele kansen die jullie me geboden hebben; voor het warme nest dat jullie voor jullie kinderen en kleinkinderen zijn, waar we altijd en op ieder moment welkom zijn; en voor jullie luisterende oor, de zeer gewaardeerde hulp, jullie onvoorwaardelijke steun en het immense vertrouwen.

Als laatste wil ik mijn eigen gezinnetje ongelooflijk hard bedanken. Ons liefste Onnootje, bedankt voor de vele ontspannende wandelingen waarop ik soms de meest geniale invallen had, voor de wilde spelletjes en de zachte knuffeltjes. Mijn allerliefste Stijn, amai, ik denk dat ik hier niet kan beschrijven hoeveel ik aan jou te danken heb. Ik wil je bedanken voor je onuitputtelijke geloof en je vertrouwen, je steun en je moed, je zorgen en je troosten, je helpen en je luisteren, je kook- en strijkkunsten, je grappen en je grollen, je enthousiasme en je rust, je geduld en je liefde. Merci dat je er samen met mij helemaal voor bent gegaan! Als laatste bedank ik onze grootste schat Alwin, jij maakt elke dag zo mooi, dat is niet te doen! Dankzij jou kon ik dit doctoraat opeens zoveel beter relativeren en het was heerlijk om tijdens het werk jouw kreetjes te horen, of een klein handje aan mijn rok te voelen trekken dat kwam zeggen dat het nu toch wel echt tijd was voor een pauze. Bedankt voor je heerlijke lachjes, giechels, oohtjes en aahtjes, woordjes, gebaren, dansjes, liedjes en knuffels.

En zo, dankzij jullie, ben ik er geraakt. Ik ben er, wow!

Genieten jullie mee van het uitzicht?

Abstract

Key word signing (KWS) is a form of augmentative and alternative communication (AAC) frequently used with both children and adults with intellectual disabilities (ID). Communication problems are common in people with ID, and can be caused by their ID and/or by additional disorders. AAC offers different methods to address these communication problems and let people with ID make use of their communicative abilities to the fullest. KWS is one of many AAC systems that can be used (often combined with other systems such as visualisations and speech-generating devices) to support both receptive and expressive communication. It can be used to offer young children a tool for the earliest interactions, to aid in language development, and as a functional, everyday communication means both in children and in adults. The latter group was the focus of this research project. Little is known about these adults and the way they use KWS. Most available literature studied the acquisition of KWS

and did not look beyond the therapy room, or only included young children or adolescents. The aim of this research project was to examine the functional KWS use in adults with ID in Flanders, Belgium.

A **first** step was to map the prevalence of KWS use among adults with ID, and to explore the characteristics of these KWS users and their support staff in general. This was done in a survey study, in which all Flemish residential (RP) and day care programs (DP) for adults with ID were contacted by phone. Those programs that indicated use of KWS with one or more of their clients, were asked to fill out a questionnaire. Of the 295 included RP and DP, a few over half used KWS. Programs which did not use KWS, often showed a lack of knowledge regarding KWS. A questionnaire about their KWS use was completed by 93 of the programs. A quarter of their clients actively used KWS. Most adults with ID used 10 to 50 signs, whereas the majority of their support workers used fewer than 10 signs. Sign knowledge and attitude of support staff related significantly to the sign knowledge of their clients. Many service providers reported that their support staff had motivational issues concerning the implementation of KWS.

Next, three groups of variables that can be linked to KWS use were studied in this project. A first group of variables are the characteristics of the signs of the KWS system that is used. Therefore, in the **second** study of this research project, we investigated the influence of the sign characteristics of the Flemish KWS system *Spreken Met Ondersteuning van Gebaren* (SMOG, Speaking with support of signs) on the functional KWS use of 119 adults with ID. We determined the phonological, iconic, and referential characteristics of the basic SMOG signs. The functional KWS use of the 119 participating adults was evaluated using a questionnaire that was filled out by their support workers. In a generalized linear model with a negative binomial distribution (with loglink), we found that the referential characteristics (semantic category, grammatical class, and referential concreteness) had the strongest influence on sign functionality. The iconicity of the signs also played a part, but phonological characteristics were not significantly related to functional sign use.

The characteristics of the KWS users themselves are the next group of variables related to KWS use. We studied a selection of client characteristics, namely

cognition and language and communication skills, in the **third** part of this research project. In a cross-sectional observation study, we related these characteristics, as measured with standardized intelligence, language, and communication tests, of 40 participating KWS users to their functional KWS use. This functional KWS use was evaluated using a specifically developed narrative task, and during a 15-minute conversation between the KWS user and the researcher. Mental age did not relate to the KWS use of our participants. Test results on the language and communication tests only correlated with the verbal measures of the functional KWS use, but not with manual sign measures. Functional KWS use during the narrative task did correlate significantly with KWS use during the conversation, indicating that the narrative task is a valid method for evaluating functional KWS use in adults with ID.

In the **fourth** and final study of this research project, KWS was introduced in a Flemish residential and day care service for adults with ID. This was done using a KWS program, in which we taught KWS to eight KWS ambassadors during four 2- hour workshops. In a "sign of the week" approach, 100 manual signs and the KWS approach were then gradually introduced to all support workers and clients of the service. We evaluated the functional KWS use of 15 adults with ID and communication problems in a narrative task and during a conversation with their support staff, before and after the intervention. A third group of variables possibly of influence on KWS use (besides sign and client characteristics), namely characteristics of the environment, were also investigated in this intervention study. Therefore, we evaluated the functional KWS use of the support workers before and after the intervention as well, during the conversation with their clients. The KWS use of both clients and support staff had increased significantly after the intervention. Clients used KWS for a variety of communicative functions.

The results of this research project revealed four important points of action:

1. KWS should be made more accessible in Flanders. This could be done by using the signs from *Vlaamse Gebarentaal* (VGT, Flemish Sign Language) with a KWS approach instead of the phonologically adapted SMOG signs. Using signs from VGT would also change the SMOG system into a system with an unrestricted vocabulary, which could benefit KWS users in need of a larger or

more specific vocabulary. The application of this altered KWS system in individuals with ID should be further studied.

2. Alternative methods for language and communication evaluation than the standard-ones, should be used to evaluate these skills in adults with ID who use KWS in particular and AAC in general. The developed narrative task could be a starting point, that should be examined in more detail.

3. No prerequisites should be used for allowing an adult with ID to use KWS. Every adult with ID who can understand and/or produce manual signs, can possibly benefit from using KWS. The functional use of KWS should be studied in a larger group of adults with ID, and in individuals with communication impairments that are caused by other disorders as well.

4. KWS can be introduced in a residence or day care centre for adults with ID using a KWS training program that consists of workshops and a “sign of the week” approach, combined with sufficient resources (such as photographs and video clips of the manual signs). Individual therapy is not always necessary, and many adults with ID are capable of learning KWS through their support staff. How the attitude and motivational issues of support staff could best be influenced, should be further investigated.

Our research project shows that, if these points of action were implemented, this could benefit the implementation and functional use of KWS in adults with ID. The ultimate goal of this study, as of any AAC intervention, is to support adults with ID in attaining communicative competence using their means of AAC, in this case KWS.

Korte inhoud

Key word signing (KWS) is een vorm van ondersteunde communicatie (OC) die zowel bij kinderen als bij volwassenen met een verstandelijke beperking (VB) regelmatig gebruikt wordt. Communicatieproblemen komen frequent voor bij personen met een VB en kunnen veroorzaakt worden door hun VB en/of door bijkomende beperkingen. OC biedt verschillende methoden aan om deze communicatieproblemen te ondersteunen, en om personen met een VB op die manier optimaal gebruik te laten maken van hun communicatiemogelijkheden. KWS is één van vele OC methoden, en kan zowel receptieve als expressieve communicatie ondersteunen, vaak gecombineerd met andere OC systemen zoals visualisaties of spraakcomputers. KWS kan jonge kinderen ondersteunen in hun eerste interacties, kan de taalontwikkeling stimuleren, en kan een functioneel, dagelijks communicatiemiddel zijn voor zowel kinderen als volwassenen. Deze laatsten zijn de doelgroep van dit onderzoeksproject. We

weten erg weinig over deze volwassen KWS gebruikers, en over de manier waarop ze KWS gebruiken. In de literatuur werd vooral de verwerving van KWS bestudeerd, maar het gebruik van KWS buiten het therapielokaal werd slechts zelden onderzocht. Ook includeerden de meeste studies kinderen en adolescenten in plaats van volwassenen. Het doel van dit onderzoeksproject was dan ook om het functionele gebruik van KWS bij volwassenen met een VB in Vlaanderen te onderzoeken.

Een **eerste** stap in dit project was het in kaart brengen van de prevalentie van KWS bij volwassenen met een VB, en het bestuderen van de eigenschappen van deze KWS gebruikers en hun begeleiders in het algemeen. Hiervoor werd een vragenlijstonderzoek opgezet. We contacteerden alle Vlaamse residentiële voorzieningen en dagcentra voor volwassenen met een VB telefonisch. Aan voorzieningen die aangaven dat ze KWS gebruikten met één of meer van hun cliënten, vroegen we om een vragenlijst in te vullen. Meer dan de helft van de 295 geïncludeerde voorzieningen gaven aan KWS te gebruiken. Voorzieningen die geen KWS gebruikten, bleken vaak een gebrek aan kennis in verband met KWS te hebben. De meerderheid van de voorzieningen die KWS gebruikten (93) vulden een vragenlijst over dit KWS gebruik in. Ze gaven aan dat een kwart van hun cliënten KWS actief gebruikten. De meeste volwassenen met een VB gebruikten 10 tot 50 gebaren, terwijl de meerderheid van hun begeleiders minder dan 10 gebaren gebruikten. De gebarenkennis en attitude van de begeleiders correleerden significant met de gebarenkennis van hun cliënten. Veel voorzieningen gaven aan dat hun begeleiders motivatieproblemen hadden in verband met de implementatie van KWS.

Hierna werden drie groepen van variabelen, die gerelateerd kunnen worden aan KWS gebruik, bestudeerd in dit project. Een eerste groep van variabelen zijn eigenschappen van de gebaren die gebruikt worden in het KWS systeem. In de **tweede** studie van dit onderzoeksproject bestudeerden we daarom de invloed van de gebareneigenschappen van het Vlaamse KWS systeem *Spreken Met Ondersteuning van Gebaren* (SMOG) op het functionele KWS gebruik van 119 volwassenen met een VB. We bepaalden hiertoe de fonologische, iconische en referentiële eigenschappen van het basis lexicon van SMOG. Het functionele KWS gebruik van de 119 deelnemende volwassenen werd met een vragenlijst, die ingevuld werd door hun begeleiders, geëvalueerd. Een generalized linear model met negatieve binomiale verdeling (met loglink) toonde aan dat de referentiële gebareneigenschappen (semantische categorie, grammaticale klasse, en referentiële concreetheid) de sterkste invloed hadden op gebarenfunctionaliteit. De iconiciteit van de gebaren speelde ook een rol, maar de fonologische gebareneigenschappen waren niet significant gerelateerd aan hun functionaliteit.

In een volgende stap wilden we de eigenschappen van de KWS gebruikers zelf relateren aan hun KWS gebruik. We bestudeerden een selectie van cliënteigenschappen, namelijk hun cognitieve, taal-, en communicatievaardigheden, in het **derde** deel van dit onderzoeksproject. We relateerden de eigenschappen van 40 KWS gebruikers, gemeten met gestandaardiseerde intelligentie-, taal- en communicatietests, aan hun functionele gebruik van KWS in een cross-sectionele observatiestudie. Dit functionele KWS gebruik werd geëvalueerd met een specifiek ontwikkelde narratieve taak en tijdens een 15 minuten durende conversatie tussen de KWS gebruiker en de onderzoeker. De mentale leeftijd van onze deelnemers was niet gerelateerd met hun KWS gebruik. De testresultaten op de taal- en communicatietests correleerden enkel met de verbale metingen van het functionele KWS gebruik, maar niet met de gebarenmetingen. Het functionele KWS gebruik tijdens de narratieve taak correleerde significant met het KWS gebruik tijdens de conversatie. Dit geeft aan dat de narratieve taak een valide methode is om het functionele KWS gebruik te evalueren bij volwassenen met een VB.

In de **vierde** en laatste studie van dit onderzoeksproject introduceerden we KWS in een Vlaamse voorziening voor volwassenen met een VB. Tijdens vier workshops leerden we KWS aan acht KWS ambassadeurs. In een 12 maanden durende interventie, met een “gebaar van de week” aanpak, werden 100 gebaren en de KWS methodiek gradueel aangeleerd aan alle begeleiders en cliënten van de voorziening. We evalueerden het functionele KWS gebruik van 15 cliënten met communicatieproblemen voor en na de interventie, met een narratieve taak en tijdens een conversatie met hun begeleider. Een derde groep van variabelen die mogelijk van invloed zijn op KWS gebruik (naast gebaren- en cliënteigenschappen), namelijk omgevingseigenschappen, werd ook onderzocht in deze interventiestudie. Hiertoe evalueerden we ook het functionele KWS gebruik van de begeleiders voor en na de interventie, tijdens de conversatie met hun cliënten. Het functionele KWS gebruik van zowel de cliënten als hun begeleiders was significant toegenomen na de interventie. Ook gebruikten de cliënten KWS voor een ruim scala aan communicatieve functies.

De resultaten van dit onderzoeksproject legden vier werkpunten bloot:

1. KWS moet toegankelijker gemaakt worden in Vlaanderen. Dit zou kunnen gebeuren door gebaren uit de Vlaamse Gebarentaal (VGT) met een KWS methodiek te gebruiken in plaats van de fonologisch aangepaste SMOG gebaren. Het gebruik van VGT gebaren zou het SMOG systeem ook veranderen in een systeem met een ongelimiteerde gebarenschat, wat ten goede zou komen aan de noden van KWS gebruikers die een grotere of meer specifieke gebarenschat nodig hebben. De toepassing van dit nieuwe KWS systeem bij personen met een VB zou verder onderzocht moeten worden.

2. Het evalueren van de taal- en communicatievaardigheden bij volwassenen met een VB die KWS (en OC in het algemeen) gebruiken, zou moeten gebeuren met alternatieve evaluatiemethoden in plaats van met de bestaande standaardtests. De narratieve taak die voor dit onderzoeksproject ontwikkeld werd, vormt hiertoe een eerste aanzet. Deze taak zou verder geëvalueerd moeten worden.

3. Er mogen geen voorwaarden gesteld worden om een volwassene met een VB een KWS interventie aan te bieden. Iedere volwassene met een VB die gebaren kan begrijpen en/of gebruiken, kan mogelijk baat hebben bij het gebruik van KWS. Het functionele gebruik van KWS zou bij een grotere groep volwassenen met een VB bestudeerd moeten worden, alsook bij personen met communicatieproblemen die veroorzaakt worden door andere stoornissen.

4. Het is mogelijk om KWS te introduceren in een voorziening voor volwassenen met een VB met behulp van een KWS interventie die bestaat uit workshops voor begeleiders en een “gebaar van de week” aanpak, gecombineerd met voldoende hulpmiddelen (zoals foto’s en video clips van de gebaren). Individuele therapie blijkt op die manier niet altijd noodzakelijk, en vele volwassenen met een VB kunnen KWS leren via hun begeleiders. De

manier waarop de attitude en motivatieproblemen van begeleiders aangepakt zouden kunnen worden, moet verder onderzocht worden.

Dit onderzoeksproject toont aan dat, wanneer voorgenoemde werkpunten verwezenlijkt zouden worden, dit de implementatie en het functionele gebruik van KWS bij volwassenen met een VB ten goede zou kunnen komen. Het ultieme doel van deze studie is, net als bij iedere OC interventie, om volwassenen met een VB te ondersteunen in het verkrijgen van communicatieve competentie met behulp van hun OC middel, in dit geval KWS.

Acronyms and abbreviations

%ile	percentile
AAC	augmentative and alternative communication
AAIDD	American Association on Intellectual and Developmental Disabilities
APA	American Psychiatric Association
ASD	autism spectrum disorders
ASHA	American Speech-Language-Hearing Association
ASL	American Sign Language
Ba	balanced
Bi	bilateral
BSL	British Sign Language
C	conversation language sample
CA	chronological age
CaV	categorical variable
COMFOR	principal component ComFor
CoV	continuous variable
CPZ	CommunicatieProfiel-Z (Communication Profile-Z)
D	dominant hand
DEM	Demey (2005)
DGS	Deutsche Gebärdensprache (German Sign Language)
DP	day care program
DS	Down syndrome
DT	dominant hand after transition
ES	effect size
FAPD	Flemish agency for persons with a disability
FET	Fisher's exact test
FTE	full-time equivalent
FXS	Fragile X syndrome
HamNoSys	Hamburg Sign Language Notation System
HNS	HamNoSys (Hanke, 2004)
ID	intellectual disability
KWS	key word signing
KWSA	Key Word Sign Australia
M	manual signs
MA	mental age
max	maximum
MC	manual signing principal component
MCF	number of different communicative functions for manual signs
MDIFF	number of different manual signs
MeSH	Medical Subject Headings
min	minimum

MLST	mean length of sign turn
MLU	mean length of utterance
MSGS	manual signing story grammar score
MSIGN	number of signs
MTTR	type token ratio manual signing
MUTT	number of manual signing utterances
M-VUTT	number of manual signing utterances without verbal language
N	narrative task
ND	nondominant hand
NDT	nondominant hand after transition
NESS	Neurological Examination for Subtle Signs
NGT	Nederlandse Gebarentaal (Dutch Sign Language)
NJC	National Joint Committee for the Communicative Needs of Persons With Severe Disabilities
NmG	Nederlands met Gebaren (Dutch with signs)
NS	not specified
ns	not significant
OC	ondersteunde communicatie (augmentative and alternative communication)
P. nr.	picture number
P.E.C.S.	picture exchange communication system
PCA	principal component analysis
PIPS	Preschool Imitation and Praxis Scale
PPVT III-NL	Peabody Picture Vocabylary Test III-NL
PR	program
RP	residential program
SGC	story grammar component
SGS	story grammar score
SLP	speech-language pathologist
SMOG	Spreken Met Ondersteuning van Gebaren (speaking with support of signs)
SUTT	number of simultaneous utterances (verbal language with support of manual signs)
TTR	type token ratio
TUTT	total number of utterances (verbal language with support of manual signs, verbal language without support of manual signs, manual signs without verbal language)
U. nr.	utterance number
UBa	unbalanced
V	verbal language
VB	verstandelijke beperking (intellectual disability)
VC	verbal principal component
VCF	number of different communicative functions for verbal language
VDIFF	number of different words

VFB	video feedback
VGT	Vlaamse Gebarentaal (Flemish Sign Language)
V-MUTT	number of verbal language utterances without manual signs
VOCA	voice output communication aid
VSGS	verbal language story grammar score
VTTR	type token ratio verbal language
VUTT	number of verbal language utterances
VWORD	number of words
WAIS	Wechsler Adult Intelligence Scale
WHO	World Health Organization
WPPSI	Wechsler Preschool and Primary Scale of Intelligence

Table of contents

Chapter 1
General introduction

Communication is a basic right for each human being (American Speech-Language-Hearing Association [ASHA], 1991; National Joint Committee for the Communicative Needs of Persons With Severe Disabilities [NJC], 1992). It is through communication that we can affect the conditions of our own existence, by for example requesting, refusing, choosing, and other communicative functions. For most people, communication happens almost automatically, without much effort. People with intellectual disability (ID) however, may experience difficulties trying to understand their environment or to express themselves, and some of them may not develop any verbal-linguistic communication at all (Abbeduto, Warren, & Conners, 2007; Roberts, Chapman, & Warren, 2008; Warren & Abbeduto, 2007). When these communication barriers are left unattended, they can have a serious impact on a person's independence and quality of life (Chadwick, Cuddy, Kusel, & Taylor, 2005). It is therefore important to offer communication support to people who struggle with conventional spoken language. Augmentative and alternative communication (AAC) comprises all possible communication forms that can be used by people who experience difficulties using verbal language (ASHA, 2005). Key word signing (KWS) is one possible AAC form that is used frequently with both children and adults with ID. Research has mainly focused on the acquisition of KWS by children and adolescents with ID, but little is known about the use of KWS as a functional means of communication in adults with ID. Therefore, in this research project, the functional use of KWS in adults with ID is studied. The main research aims are to map the prevalence of KWS use among adults with ID and to explore the relationships between different sign, client, and environmental characteristics and the functional use of KWS by adults with ID. This is done in two survey studies, a cross-sectional, and an intervention study. Ultimately, the aim of this study is to critically evaluate the way KWS is used on an everyday basis in adults with ID, and to examine if and how functional KWS use could be improved in this population.

In this first chapter, the background of and rationale for the topic of this research project are sketched. In succession we discuss adults with ID and typical features of their communication, AAC, and KWS. Finally, the general outline of this research project is described.

1.1. Adults with intellectual disability

1.1.1. Intellectual disability

Adults with an intellectual disability are the main participants in this study. Intellectual disability (ID) is defined as follows by the American Association on Intellectual and Developmental Disabilities (AAIDD, 2013, p. 1):

"Intellectual disability is a disability characterized by significant limitations in both intellectual functioning and in adaptive behaviour, which covers many everyday social and practical skills. This disability originates before the age of 18.

Intellectual functioning—also called intelligence—refers to general mental capacity, such as learning, reasoning, problem solving, and so on. One way to measure intellectual functioning is an IQ test. Generally, an IQ test score of around 70 or as high as 75 indicates a limitation in intellectual functioning."

The prevalence of ID varies between 1% and 3% worldwide, depending on study methodology, sample size and operational definitions (Maulik, Mascarenhas, Mathers, Dua, & Saxena, 2011; World Health Organization [WHO], 2001). About 85% of the individuals with ID have a mild ID (IQ between 50-55 and 70), with the remaining 15% having a moderate (IQ between 35-40 and 50-55), severe (IQ between 20-25 and 35-40), or profound ID (IQ below 20-25; American Psychiatric Association [APA], 2013a; Crocker, 1989). It is necessary not to base the diagnosis of ID solely on IQ scores, but to also include adaptive behaviour as a key indicator (APA, 2013b). Adaptive behaviour is defined as "the collection of conceptual, social, and practical skills that are learned and performed by people in their everyday lives" (AAIDD, 2013, p. 1). **Conceptual** skills include language and literacy, money, time, and number concepts; among **social** skills are interpersonal skills, social responsibility, and self-esteem; and **practical** skills refer to activities of daily living, occupational skills, healthcare, and so on. Limitations in adaptive behaviour can be determined using standardized questionnaires, such as the *Vineland Adaptive Behavior Scales* (Sparrow, Balla, & Cicchetti, 2005).

ID can be caused by a great variety of conditions, but the aetiology of ID remains unknown for many individuals with ID. The causes of ID can be described as hereditary disorders (e.g., chromosomal aberrations such as fragile X syndrome), early alterations of embryonic development (e.g., chromosomal changes such as Down syndrome [DS]), other pregnancy problems (e.g., foetal alcohol syndrome) or perinatal morbidity (e.g., hypoxia), acquired childhood diseases (e.g., encephalitis), environmental problems and behavioural syndromes (e.g., childhood psychosis), and other unknown causes (Crocker, 1989). The most common genetic disorders causing ID are DS, with a prevalence of 1:650 to 1:1,000 births, and fragile X syndrome, with a prevalence of 1:4,000 (for men) to 1:12,000 (for women) births. In both syndromes, communication problems are very common (Martin, 2010).

1.1.2. Communication in adults with ID

Communication entails a bilateral contact between people, in which a transfer of information takes place. It is essential to attaining quality of life, because "the ability to communicate is at the very centre of people's lives, for communication allows people to express their thoughts and feelings, to define who they are, to connect with others in meaningful ways, and to participate in education and work" (Light, Beukelman, & Reichle, 2003, p. ix). A definition of communication is given by the NJC (1992, p. 3).

"Communication is any act by which one person gives to or receives from another person information about that person's needs, desires, perceptions, knowledge, or effective states. Communication may be intentional or unintentional, may involve conventional or unconventional signals, may take linguistic or nonlinguistic forms, and may occur through spoken or other modes."

This definition clearly indicates that speech is only one mode of communication, which is a complex whole of all kinds of communicative behaviour. People may use spoken words, but also eye contact, facial expression, pointing, manual signs, pictograms, and so on, to communicate. When a person cannot talk, it does not mean that he or she cannot communicate. Every nonspeaking person has the right to communicate to the fullest extent possible (ASHA, 2004; Light et al., 2003; NJC, 1992). For some people who use other communication modes than conventional speech, it might be challenging to create the conditions in which an unaltered transfer of their message can take place. Their communication partners must know and apply the rules of their specific form of communication in order for the communicative act to be successful. At this point, communication with persons with ID often fails.

Communication problems are frequent in adults with ID, as is clear from the definition of ID. Within this definition, there is reference to communication as part of both conceptual skills (including language and literacy) and social skills (including interpersonal skills). Estimations of the prevalence of communication problems among adults with ID vary greatly, depending on the degrees of ID studied and/or the methodology used. Survey studies have estimated that over 29% of British adults with ID are nonverbal (Blackwell et al., 1989) and that 23 up to 74% of Australian and New Zealand individuals with ID have a "speech impairment" (Bray, 2003, p. 3). Generally, it is estimated that over 50% of individuals with ID experience some kind of problem when communicating (De Bal, 2005). Communication problems in individuals with ID can be described in relation to the severity and the aetiology of their ID.

Although many people with ID are capable of developing spoken language, most of them still experience semantic, morphosyntactic, and/or pragmatic language disorders (Abbeduto & Hesketh, 1997; Chew, Iacono, & Tracy, 2009; Hatton, 1998; Rice, Warren, & Betz, 2005; Rondal, 2001). Some individuals with ID however, will not develop any spoken language. The reasons for not developing spoken language can be varied. Learning language is founded upon different social, perceptual, emotional, cognitive, conceptual, and linguistic processes, which all interact (Johnston, 2010). For some individuals with ID, perceptual disabilities will mainly influence their deficits in language learning, but for others, their cognitive disabilities will mostly determine the outcome of their language development. Communication in adults with a profound ID for example, will mainly take place on a non- or presymbolic level. They will rarely develop any spoken language (Chew et al., 2009). ID are also often associated with additional disorders, such as (perceptual-) motor (Elliott & Bunn, 2004), behavioural (McClintock, Hall, & Oliver, 2003), and psychiatric (Emerson, 2003) disorders. These problems may hinder the development of spoken language as well.

Spoken language skills of adults with ID who do possess verbal language, have mainly been studied in individuals with DS. People with DS frequently experience problems with spoken language (Abbeduto et al., 2007; Martin, Klusek, Estigarribia, & Roberts, 2009; Roberts, Price, & Malkin, 2007). First of all, **speech** of individuals with DS is often poorly intelligible. This problem can be caused by their ID, but also by neurological and anatomical differences compared to typically developing individuals. Anatomically, DS is associated with hypotonia, a larger tongue size relative to a smaller oral cavity, and poorly differentiated midfacial muscles (Abbeduto et al., 2007; Martin et al., 2009; Roberts et al., 2007; Hustad & Shapley, 2003; Treviranus & Roberts, 2003). These features may cause articulation, vocal, and resonatory problems, which lead to a poor speech intelligibility. Phonological problems are often present in individuals with DS as well (Abbeduto et al., 2007; Martin et al., 2009; Roberts et al., 2007). They can be related to their ID, neurological impairment, brain morphology, processing difficulties, and memory deficits (Treviranus & Roberts, 2003). Dichotic listening procedures and neuroimaging studies have indicated that people with DS demonstrate a biological dissociation between systems responsible for speech perception (right-hemisphere specialized) and systems responsible for speech production (in addition to the organization and control of other oral and manual movements, left-hemisphere specialized). This leads to verbal-motor integration problems, phonological problems, and subsequently to speech intelligibility problems (Elliott & Bunn, 2004). Fluency disorders are also frequently present in people with DS and may negatively influence speech intelligibility as well (Hustad & Shapley, 2003). Besides speech problems, most individuals with DS also experience **language** deficits (Abbeduto et al., 2007; Martin et al., 2009; Roberts et al., 2007). Children with DS generally have better receptive compared with expressive language skills, and better semantic compared with morphosyntactic skills. Notwithstanding deficits in expressive language and receptive morphosyntax in most children with DS, these skills have been found to continuously develop into adolescence and young adulthood (Abbeduto et al., 2007; Chapman, 2003; Chapman & Hesketh, 2001; Roberts et al., 2007). Nevertheless, in adults with DS problems with expressive language and morphosyntax are still common (Chapman & Hesketh, 2001; Iacono, Torr, & Wong, 2010). These problems can often be related to auditory/verbal short term memory and working memory deficits (Vicari, 2006). Auditory short term memory has been found to predict both expressive and receptive language skills in individuals with DS, but age and visual short term memory also play a part (Chapman & Hesketh, 2001). Expressive language and auditory short term memory deficits become worse with increasing age, whether adults with DS develop dementia or not. They are indeed more vulnerable to develop dementia compared with typically developing peers, and when dementia does occur, this may additionally contribute to language and communication problems (Iacono et al., 2010).

It is clear that adults with ID may experience different types of communication problems. The consequences of these communication problems can be weighty.

Not being able to express one's desires or feelings can lead to frustrations (Romski & Sevcik, 2005). People who are not offered a suitable communication form, will generally try to express themselves through other forms of behaviour that are often perceived as problem behaviour (McLean & Snyder-McLean, 1987; Reichle, Feeley, & Johnston, 1993; Romski & Sevcik, 2005). In many cases this behaviour is not only caused by the person with ID, but also by the disturbed interaction between the person and his environment. Support staff of adults with ID do not always recognise the behaviour of their clients as communicative behaviour (Bradshaw, 2001; Hastings & Remington, 1994). Insufficient knowledge of and insight in the communicative competences of their clients may lead to a maladjusted approach from support staff, paving the way for communication breakdowns. Successful communication can be achieved by offering a suitable form of communication, and by getting the environment involved. This can diminish problem behaviour and communicative frustrations and improve the quality of life of the adult with ID (Dropic & Reichle, 2001).

1.2. Augmentative and alternative communication

1.2.1. What is augmentative and alternative communication?

Augmentative and alternative communication (AAC) is a transdisciplinary field in which several modes of communication are used to support persons who are limited in their use of conventional language (Beukelman & Mirenda, 2005; van Balkom & Welle Donker-Gimbrère, 1994). It is defined as follows by the ASHA (2005, p. 2):

"Augmentative and Alternative Communication (AAC) refers to an area of research, clinical, and educational practice. AAC involves attempts to study and when necessary compensate for temporary or permanent impairments, activity limitations and participation restrictions of individuals with severe disorders of speech-language production and/or comprehension, including spoken and written modes of communication."

Because of its transdisciplinary character, a great variety of people have contributed and still contribute to the knowledge and practice base of AAC. These people include individuals who use AAC themselves, their families and friends, educators, linguists, speech-language pathologists (SLP), occupational therapists, physical therapists, and psychologists, among others (Beukelman & Mirenda, 2005).

1.2.2. Goals of AAC

All individuals who have communication needs that exceed their communication abilities, are possible candidates for AAC. The population of individuals who use AAC is thus very heterogeneous. Some AAC users may experience motor speech problems, whereas others may have developmental speech or language deficits, or a combination of both. The ultimate goal of an AAC intervention is to enable individuals to efficiently and effectively engage in meaningful, functional communication, or in other words, to develop communicative competence (Beukelman & Mirenda, 2005; Light et al., 2003). The existing communication skills of the AAC user are supported where possible and complemented where necessary, and this way can be fully exploited (Romski & Sevcik, 2005). Any and all means available should be used for this purpose (Hustad & Shapley, 2003). AAC can serve both a language stimulating (until speech develops) and a functional communicative (as a supplement or an alternative to speech) purpose (van Balkom & Welle Donker-Gimbrère, 1994), and can be a temporary or become a permanent means of communication (ASHA, 2004). Besides supporting language production, AAC can also be a tool to help in language comprehension (e.g., as augmented input; Beukelman & Mirenda). The role of AAC is never fixed, and can vary in the course of the life of an AAC user (Murray & Goldbart, 2009).

1.2.3. Attaining communicative competence using AAC

Many factors contribute to attaining communicative competence for an AAC user (Light, 2003). These factors can be divided into intrinsic and extrinsic factors. The first group of contributing **intrinsic** factors, are related to *knowledge, judgement and skills* of the AAC user. These intrinsic factors can be described on four domains: the linguistic, operational, social and strategic domain. The linguistic domain encompasses the development of receptive and expressive skills in both the spoken language and the AAC code that is used with the AAC user. The operational domain refers to the execution of the AAC form, for example producing manual signs or operating a push-button. The development of appropriate sociolinguistic (discourse skills and communicative functions) and sociorelational skills is denoted by the social domain. The strategic domain, finally, covers the use of appropriate strategies to bypass limitations in the linguistic, operational or social domain. A second group of intrinsic factors that contribute to attaining communicative competence, are different *psychosocial factors* of the AAC user, such as the motivation to communicate, the attitude towards AAC, the communicative confidence of the individual, and his or her resilience. The **extrinsic** factors that may be of influence on communicative competence, are related to communication demands and environmental barriers and/or supports. These *communication demands* refer to the social roles of the AAC user and to the goals of his or her interactions. The four main communication goals, according to Light (2003), are: (a) expressing needs and wants, (b) developing social closeness, (c) exchanging information, and (d) fulfilling social etiquette requirements. A fifth communication goal, conducting an internal dialogue, was added by Beukelman and Mirenda (2005). Finally, the *environmental barriers and/or supports* that may contribute to attaining communicative competence for an AAC user, are related to policy (e.g., funding), practice (e.g., lack of trained professionals), attitude, knowledge, and skills of the environment (Light, 2003).

1.2.4. Components of AAC

The AAC domain encompasses four primary components: symbols, aids, strategies, and techniques (ASHA, 2004; Murray & Goldbart, 2009). The **symbols** used in an AAC system are the carriers of the information that is transferred. AAC symbols can be *aided* (for example drawings, pictures, and speech generating devices), which means that supports beyond the persons own body are needed. They can also be *unaided* (for example facial expressions, vocalizations, gestures, and manual signs), which means that no external objects or devices are used (ASHA, 2004; Beukelman & Mirenda, 2005).

Different types of symbols exist, such as vocal, visual, gestural, and tactile symbols. Some symbols are more iconic than others, with the iconicity of a symbol referring to the relationship between the symbol and its referent (see chapter 4). AAC **aids**, or devices, refer to electronic or nonelectronic appliances that are used to communicate (ASHA, 2004). Some aids are very simple, such as a communication card with a grid of pictures on it, and others can be highly technical, such as a voice output communication aid (VOCA) that operates on a computer. The **strategies** that are used in AAC systems aim at conveying the message in the most effective and efficient way possible (Beukelman & Mirenda, 2005). Examples of strategies are letter or word prediction in devices that have the alphabet as an input modus, or different scanning methods (linear or row column) in VOCAs (ASHA, 2004). AAC **techniques**, finally, refer to the various ways in which messages can be transmitted (ASHA, 2004). These techniques can be subdivided in direct selection (for example pointing at a symbol) or indirect selection (for example scanning). AAC techniques also cover the different interfaces that can be used to access the symbols in an AAC device, for example keyboards, touchscreens, or switches.

An AAC system includes rules for form, content and use of communication. Rules concerning the **form** of communication indicate how symbols can be combined to meaningful and intelligible messages. The **content** of the communication is referred to in conventions concerning the selection of vocabulary for AAC systems. Research suggests that age, gender, and cultural differences may affect the vocabulary that an individual uses during interaction, and these factors should therefore be taken into account when selecting vocabulary for an AAC user (Beukelman & Mirenda, 2005). Finally, the **use** of communication is reflected in rules that aim at enabling an effective and efficient communication between the AAC user and his or her communication partners (for example topic introduction and turn-taking; ASHA, 2004; Beukelman & Mirenda, 2005).

Multimodality is a key aspect of AAC (Loncke, Campbell, England, & Haley, 2006; also see 1.3.4). AAC should never refer to one single mode of communication, but to a system of diverse modes that are available to the AAC user. These diverse communication modes can be used alternating or combined, depending on the situation (ASHA, 2004). Different forms of AAC should never compete with each other, but should complement each other. Most AAC methods also enclose this multimodality in itself. One such explicitly multimodal AAC method that combines spoken language with manual signs, is key word signing (Loncke et al., 2006).

1.3. Key word signing

1.3.1. What is key word signing?

Key word signing (KWS) is an AAC method in which the key words in a spoken sentence are supported by a manual sign (Beukelman & Mirenda, 2005; Grove & Dockrell, 2000; Loncke, Nijs, & Smet, 1993, 1998; Nijs, Smet, & Loncke, 2003; Powell & Clibbens, 1994). Windsor and Fristoe (1989, p. 347) give the following definition:

"KWS is a form of simultaneous communication in which those words in a sentence that carry most of the meaning of the sentence are signed simultaneously with the complete spoken production of the sentence."

The syntax and grammar of the spoken language are retained, and the manual signs are produced simultaneously with the key words. Key words are those words that carry most meaning in a sentence, such as base nouns, base verbs, prepositions, adjectives, and adverbs (Beukelman & Mirenda, 2005). KWS leans closely towards the way natural speech is supplemented with gestures and body signals (see 1.3.4.1). It is a multimodal, unaided form of AAC. This multimodality is based on the assumptions that signs can be used to replace or supplement speech, and that combining signs and speech can strengthen the message and make it more redundant, which enlarges the chance that this message comes across correctly (Loncke et al., 2006; see 1.3.4). Different unaided AAC systems using manual signs exist, and most of them can be described as manual sign systems (Beukelman & Mirenda, 2005, van Balkom & Welle Donker-Gimbrère, 1994). The signs of most manual sign systems are derived from or based on signs from sign languages. **Sign languages** are full-fledged languages that originated in deaf communities around the world. They have their own lexical, morphosyntactic, and grammatical rules (Hickok, Bellugi, & Klima, 2001). In contrast to speech, which is always sequential, sign languages can express messages simultaneously. Similar to spoken languages, many countries have their own sign language and many sign languages have multiple dialects. Examples of sign languages are *American Sign Language* (ASL), *British Sign Language* (BSL), *Nederlandse Gebarentaal* (NGT, Dutch Sign Language), and *Vlaamse Gebarentaal* (VGT, Flemish Sign Language). **Manual sign systems,** in contrast to sign languages, parallel spoken languages, and are not a language in itself. Manual sign systems have been developed for people with hearing impairments for educational reasons (Moores, 1981), or for people with communication impairments originating from ID or other developmental or neurological disorders, among others. These systems code the word order, and possibly also syntax, grammar, and phonological features (for example by depicting the initial letter of a word in fingerspelling) of the spoken language in manual signs. Manual sign systems can be positioned on a continuum, with systems that code for each spoken word on one end of the continuum, and systems that only code for certain (key) words of the spoken sentence on the other end of the continuum. Examples of manual sign systems in which (almost) all spoken words are expressed with a manual sign are *Sign Supported English*, *Pidgin Sign English*, *Cued Speech*, *Signed English*, and *Signing Exact English* (Beukelman & Mirenda, 2005; Fristoe & Lloyd, 1978; Romski, Sevcik, & Joyner, 1984; Stowers, Altheide, & Shea, 1987; van Balkom & Welle Donker-Gimbrère, 1994). These signs systems are mainly used in deaf education. Manual sign systems at the other end of the continuum fall into the category of KWS and are mainly directed at people with ID. Examples of KWS are *Makaton* (Grove & Walker, 1990) and Key Word Sign Australia (KWSA; Bloomberg, 2005). More examples are described in section 1.3.6.

Unaided forms of AAC, and KWS in particular, have certain advantages over aided forms. When compared with aided AAC, KWS permits more natural interactions: communication is kept face-to-face (without a communication device standing in the middle), and attention, turn-taking, and eye contact are retained and even promoted (Clibbens, 2001; Wells, 1981). The speed of communication is higher using KWS compared with aided AAC systems (Hourcade, Pilotte, West, & Parette, 2004; Wilkinson & Hennig, 2007). Also, manual signs permit the coding of an essentially infinite number of messages (the KWS user is not or should not be restricted to a fixed, limited, vocabulary; Wilkinson & Hennig, 2007). Manual signs are subject to variations in production and can be modified and combined, which creates learning possibilities and the potential for developmental change and creativity within the communicative modality itself (Clibbens, 2001; Smith & Grove, 2003). Unaided AAC is also portable (no external devices are needed) and accessible (you always have your hands to your disposal). Manual signs can be used spontaneously because they do not have to be switched on and do not have a battery that can be exhausted. They can be used while bathing, in the sandbox, and in bed, they do not break down or get lost, and are free of charge (Beukelman & Mirenda, 2005; Clibbens, 2001; Loeding, Zangari, & Lloyd., 1990; Wells, 1981; Wilkinson & Hennig, 2007). As stated by Treviranus and Roberts (2003, p. 210): "Regardless of advances in AAC technology, unaided AAC has a place in the communication toolbox of individuals with developmental disabilities."

The basic idea of KWS is to combine speech and manual signs, but of course not all KWS users will be capable of doing so. The environment of the person with a communication disability should always present a multimodal communication model of speech and signs combined. Many people with communication problems who use KWS however, will not be able to produce (intelligible) speech and will rely mostly on the manual signs for expressive communication (Powell, 1999). However, for people with communication problems and for their communication partners, KWS involves more than just using manual signs. When using KWS, body signals and spoken language (if present) are adapted as well.

With regard to **body signals** (a term suggested by van Balkom & Welle Donker-Gimbrère, 1994, to replace body language, as body signals are not part of a linguistic system), KWS makes use of extralinguistic and contextual references as much as possible, supplemented with certain sign language features. *Extralinguistic information* can be conveyed using touch and physical contact, postural changes, eye movements and gaze, and facial expression (Beukelman & Mirenda, 2005; Hubbers, 2009; Loncke et al., 1993, 1998). These subtle physical changes allow nuances of meaning, for example irony, and enable one to add an emotional load to a message (Beukelman & Mirenda, 2005).

Contextual references are added by pointing and using the space available. When an object is present, pointing to it is the most obvious and strongest method of communication at that instant. Besides the manual signs, other *features from sign language* are also used in a KWS approach. These features include size designations, directionality and placement, and the use of classifiers (Hubbers, 2009). When a sign is used to communicate about an object with a certain size, the execution of that sign is adapted to mimic the real or relative size of that object. Directionality refers to the dynamic interaction between communication partners and/or the space in which they are situated, and how this interaction is represented when performing signs. For example, when I want to sign that you gave me a present, I will direct the GIVE[1] sign from you towards myself. Placement of signs means that an imaginary surface or wall is used on which the signs are produced. This shared visual context conveys relationships between the different subjects or objects that are signed. For example, when I want to tell you that I found a book under the table, I will produce the sign BOOK below the sign TABLE in the virtual space. Classifiers denote the use of hand shapes to refer to certain persons or objects, by indicating the size or shape of an object, or how it is handled or moved (DePaul & Yoder, 1986; Hubbers, 2009). An example is the shift from a flat hand shape, which is the generic hand shape in the VGT sign for TO WASH, to a fist when signing TO WASH the car, depicting that the hand is holding a sponge.

Besides adding body signals, **spoken language** is also adapted when using KWS. Speech is generally simplified, which means that sentences are kept short, vocabulary and sentence structure are kept simple, and speech rate is slower (Loncke et al., 1993, 1998; Nijs et al., 2003). This is done intentionally, but also occurs automatically when speech is combined with manual signs. The coordination and synchronization of both communication modalities causes a slower speaking rate and longer pause time (Windsor & Fristoe, 1991). These simplifications and alterations may enhance comprehensibility of the spoken language produced when using KWS. The spoken language produced by adults with ID who use KWS is altered as well. Their speech is perceived as more

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[1] Throughout this document, words that refer to manual signs are written in uppercase.

intelligible, even by raters who cannot see the signs that the adults with ID produce (Powell & Clibbens, 1994).

1.3.2. Goals of KWS

The goals of KWS are similar to those of AAC in general. The primary goal of a KWS intervention is for the KWS user to attain communicative competence. KWS can be used temporarily or permanently, and can support language comprehension and production. When used by the environment of a person with communication problems, KWS can assist to a person's **comprehension** of spoken language. KWS can also be used for language **production**, when replacing speech, supporting unintelligible speech, or stimulating speech production and/or language development. It can be used **temporarily** to support symbolization and initial language development in young children. Because KWS offers a more accessible language modality, linguistic awareness can increase, leading to an expansion of the internal linguistic network of the KWS user. This can stimulate language development (Loncke et al., 1993, 1998; Nijs et al., 2003). It can also be used temporarily by adults with a temporary loss of speech, for example in adults with aphasia. For some individuals, KWS can become a **permanent** means of communication. Individuals who do not develop intelligible speech or who need permanent support in speech production, can adapt KWS as their main means of communication (Loncke et al., 1993, 1998; Nijs et al., 2003).

1.3.3. Users of KWS

KWS can be used by all people who have a communication problem and who are able to understand and/or produce manual signs. Kiernan, Reid, and Jones (1982, in Grove & Walker, 1990, p.17) estimated that "up to one in three of the total population of people with severe learning difficulties may be candidates for sign or symbol programs". A survey on the AAC use among the clients of 214 SLPs in New Zealand (Sutherland, Gillon, & Yoder, 2005) revealed that "sign language" (which probably refers to KWS, see section 1.3.6) was used with children with cerebral palsy, autism spectrum disorders (ASD), hearing impairments, and dyspraxia, but mostly with children with developmental delay, DS, and ID in general. With regard to the adult clients of the surveyed

SLPs, KWS was used with adults with cerebrovascular accidents, traumatic brain injury, motor neuron disease, cerebral palsy, and mostly with adults with ID. Research has shown that both children and adults with ID can and do learn manual signs when they have problems acquiring or producing speech, and that they are able to use those manual signs to develop meaningful communication (Grove, 1980; Powell, 1999; see chapter 2). Most manual sign systems that are applied in people with ID, can be categorized as KWS systems (Grove & Walker, 1990).

1.3.4. Characteristics of a KWS system

A KWS system can be defined by three groups of characteristics: (a) sign characteristics, (b) client characteristics, and (c) environmental characteristics (see Figure 1.1). These characteristics may influence KWS acquisition, recall and (functional) use.

Figure 1.1. Characteristics of a KWS system.

1.3.4.1. Sign characteristics

The symbols used in a KWS system are manual signs. A sign can be defined as “a movement of the body that gives information or an instruction” (Cambridge Dictionaries Online, 2014). Manual signs are a motor-visual communication form. They are a very natural manner of communication, which most people use spontaneously when communicating. These spontaneous manual signs are often called gestures or natural signs. Gestures do not rely on conventions, but are naturally understood by most people (although they may be culturally determined). They are an important and integral part of human interaction. Gestures and spoken words complement and influence each other (McNeill, Alibali, & Evans, 2000). According to McNeill (1985, 1992), gestures are inextricably connected to spoken language. Gestures are usually described as meaningful movements of arm and hand, but, in a broader sense, they also include facial expressions and gaze shifts (Quek et al., 2002). The functions of gestures can be to convey a message, to illustrate what is being said, to display emotional states, and to introduce structure in conversational speech (Beukelman & Mirenda, 2005). McNeill (1992) mentioned different types of gestures, which can be perceived on a continuum, with gesticulations (accompanying verbal discourse) at one end, and sign languages at the other end. We would suggest placing signs that are used in a KWS method, in between. They also accompany speech, but they are generally more iconic than gesticulations (see further). Gesticulations however, according to McNeill, can be iconic as well. He distinguished functional or non-imagistic gesticulations (called “beats”, which have a rhythmically-pragmatic function), and referential or imagistic gesticulations. The latter can be divided into deictics (pointing), iconics, and metaphorics. Iconics exhibit images of their referents, whereas metaphorics exhibit images that are used as metaphors for abstract concepts. Both deictics, iconics, and methaphorics show overlaps with the way manual signs are used in a KWS approach. We believe that, although signs from sign languages are used, the methodology that is used in KWS has more in common with the way gestures are used in relation to speech, which we will motivate next.

One indication for the signs in KWS being closely related to gesticulations, comes from the fact that the psycholinguistic feasibility of KWS is much higher than that of manually coded languages (such as Manually Coded English, MCE; Swisher & Thompson, 1985). When using MCE, teachers and caregivers of deaf children try to sign all words in a spoken sentence simultaneously, in an effort to enable the deaf child to visually perceive the linguistic structure of the spoken language (Swisher & Thompson, 1985). Several studies have pointed out, however, that producing MCE is very difficult -if not impossible- even for experienced and highly motivated teachers and parents (Strong & Charlson, 1987; Swisher & Thompson, 1985; Wilbur & Petersen, 1998). The majority of the expressions of the MCE users in these studies were ungrammatical or incomplete, and mostly function signs were omitted (e.g., prepositions, articles, pronouns, and auxiliary verbs). Signs for information carrying words, such as nouns and main verbs, were rarely omitted. This means that, in fact, many of the participant's utterances leaned more towards KWS than MCE. Apparently, when people combine speech and manual signs, they automatically evolve into a KWS-like approach. Research by Goldin-Meadow, McNeill, and Singleton (1996) also points in this direction. They found that when (hearing) adults produce gestures together with speech, these gestures do not have grammatical properties. They have a global and mimetic character instead of a segmented and hierarchical one (both hallmarks of grammatical structure; Goldin-Meadow et al., 1996). When adults were asked to describe a situation only using gestures, they spontaneously added segmentation and hierarchy, and thus grammatical structure, to them. Deaf children from hearing parents who were not exposed to sign language, also have been found to create gesture systems with grammatical properties (Goldin-Meadow et al., 1996). This can be related to our proposal to consider the signs that are used in KWS, in which manual signs accompany speech, as more gesture-like than sign language-like, from a psycholinguistic point of view. Of course, gestures are usually newly created, whereas signs need to be retrieved from a mental lexicon (Loncke et al., 2006). This indicates that using KWS does require greater cognitive effort compared to using gestures while speaking. Still, with practice, this retrieval can occur spontaneously, just like word retrieval occurs when speaking. Memory, of course, is a crucial factor for this lexical retrieval process (Beukelman & Mirenda, 2005; Loncke et al., 1993, 1998; Rowland & Schweigert, 2003, see 1.3.4.2). Iconicity can be an important factor with regard to the learning of signs and building up this lexicon (Loncke et al., 2006) although its relation to the actual retrieval of acquired signs can be questioned (Orlansky & Bonvillian, 1984, see further). Also, manual signs, just like gestures, are thought to be very closely intertwined with speech in their initial cognitive origin and representation.

In natural communication, gestures and speech function as one synchronous whole (McNeill, 1985, 1992). McNeill found that 90% of gestures spontaneously produced by hearing adults, were accompanied with speech. The auditory and visual modality are not subservient to each other in this matter, but complementary (Loncke et al., 2006; McNeill, 1985, 1992). Gestures and speech are part of the same psychological structure, and share a computational stage (McNeill, 1985). Gestures and speech, at a preverbal semantic-conceptual level, proceed together from the same idea, which McNeill calls a growth point, in which speech, gestures, and thoughts occur simultaneously. He views the origin of thought as imagistic (which can be related to the concept of embodied cognition, Corballis, 2010), and gesture as its natural mode of expression. Although gestures and speech belong to different modalities, they are linked on several levels and coexpressively present the same ideas. Gestures are simultaneous, global expressions, whereas speech is hierarchical, linear, segmented, and analytic (Goldin-Meadow et al., 1996; McNeill, 1992). Words and iconic gestures or manual signs are thought to be mentally stored in a single, integrated network, with perception of one form triggering the recognition of the other (Loncke et al., 1992). This way, multimodality may facilitate the representation, storage, and retrieval of information expressed when combining speech and gestures or manual signs.

When looking at the origin of language, the gestural theory suggests that spoken language emerged from gestures (Bonvillian, Garber, & Dell, 1997; Corballis, 2009, 2010, 2013). Early humans communicated primarily in (iconic) gestures, and gradually added facial expressions, mouth movements, vocalisations, and finally speech to these gestures (Corballis, 2009). From a developmental point of view as well, language and gestures are closely related. Gestures are necessary for the acquisition of speech (Corballis, 2009). Correlations between different levels of gestural communication and language developmental milestones have been found (Bates & Dick, 2002). Deictic gestures (giving and pointing) for example, have been found to correlate strongly to lexicon sizes during language development of both spoken and sign language (Folven, Bonvillian, & Orlansky, 1984). Children acquiring sign language, however, were found to produce their first manual signs before the appearance of giving and pointing, whereas the first spoken words typically appeared afterwards (Folven et al., 1984). In children with ID, word comprehension and gesture production have been found to be both, and comparably, delayed (Bates & Dick, 2002). Still, because of the earlier appearance of gestures in infant communication, gestures and manual signs might be easier accessible for individuals with ID compared to spoken language. Also, gestures, when used by their environment, may make spoken language easier accessible (see 1.3.4.2).

This close interconnection between language, speech, and gestures, might explain why KWS can be produced by persons with and without ID with a seemingly high psycholinguistic ease. When we use KWS, the goal should be to use it in a gestural way, which means to simultaneously produce speech and signs, emerging from the same idea (cf. McNeills theory). We should avoid using it in a MCE way, where an idea is first converted into (internal) speech, with this speech forming the basis for the signs that are produced. These signs are then not simultaneous and global in nature anymore, but are forced into a sequential and analytical structure (paralleling speech), which actually does not suit them. This takes a lot more cognitive effort, making it a method too difficult for spontaneous communication. KWS, when only using a limited number of manual signs and only for information carrying words, is capable of preserving the simultaneous and global nature of manual signs in favour of psycholinguistic feasibility.

Most KWS systems use manual signs that were taken from or adapted from sign languages (see section 1.3.1). Signs from a sign language are considered as linguistic entities. They can be described in terms of phonological, iconic, and referential characteristics. Sometimes, signs have been adapted for use with people with intellectual, developmental, and/or motor disabilities (see section 1.3.6). These adaptations mainly entail the simplification of phonological features. The **phonology** of a sign refers to its motor execution. The most studied phonological sign characteristics are hand shape, movement, location, orientation, and nonmanual features (McEwen & Lloyd, 1990). The way in which phonological sign characteristics influence sign learning has mostly been studied in relation to the typical motor development of young children. A review by Doherty (1985) suggests that hand shape is the most difficult parameter to acquire and location the easiest. **Iconic** sign characteristics refer to the visual relationship between the sign and its referent (Markham & Justice, 2004). Two frequently studied aspects of iconicity are transparency and translucency. Transparency means the guessability of a sign, and translucency refers to how closely related the sign and its referent are judged to be (Doherty, 1985; Grove, 1980). Much more than transparency, translucency has been found to facilitate sign learning in individuals with and without ID (Doherty, 1985; Luftig, 1982, 1983). On the other hand, iconicity and symbol learning are culture, time, and experience bound. The influence of translucency and transparency on sign learning thus varies largely across different studies (Beukelman & Mirenda, 2005). For example, iconicity does not seem of that great importance in young children acquiring sign language (Orlansky & Bonvillian, 1984). The **referential** characteristics of a sign relate to its meaning. Signs can represent concepts that are concrete or abstract (Grove, 1980), and sign referents possess semantic and grammatical features.

The characteristics of a sign have an influence on its learnability and ease of use. There is no clear consensus in literature on which precise influence they have and on which signs are easiest and which are most difficult, but some overall directives can be formulated (Bryen & Joyce, 1986; Grove, 1990; Lloyd & Doherty, 1983; McEwen & Lloyd, 1990). In general, signs that are built up of hand shapes and movements which appear early in the typical motor development (such as flat and fist hand shapes [see Appendix A]; Bonvillian & Siedlecki, 2000; Boyes Braem, 1990; Siedlecki & Bonvillian, 1997; and symmetrical movements; Bonvillian & Siedlecki, 1998; McEwen & Lloyd, 1990) are thought to be easiest to learn (Grove, 1980). Signs that involve contact and that are visible to the signer, are expected to be easier to learn than signs that do not involve touch or that are executed outside the signer's field of vision (Grove, 1990; Lloyd & Doherty, 1983). Also, translucent, concrete signs and signs depicting actions (recreating all or part of a motor sequence) are thought to be easier to learn compared with nontranslucent, abstract, and nonaction signs (Grove, 1980). Most importantly however, the signs that are used with a person need to be functional for this person. This means that often, little account can be taken of these guidelines, because functionality and learnability of signs seem to be at least somewhat incompatible (Luftig, 1983). For an in-depth literature review concerning the characteristics of manual signs we refer to chapter 4.

1.3.4.2. Client characteristics

Besides sign characteristics, another set of variables that might influence KWS learning and use are personal characteristics of the KWS user. The client characteristics mostly described in relation to KWS are situated in the fields of cognition, language and communication, and motor abilities.

Different **cognitive** aspects have been found to be of importance in relation to language development and acquisition, and many of them can be related to gestures and eventually to manual signs and KWS. Hereafter, we will discuss the roles of attention, perception and multimodal information processing, imitation, memory, theory of mind, degree of ID, and symbolic representation.

Two of the most basal aspects with regard to language acquisition are *attention* and *perception*. Traditional Piagetian theory stated that infants grow up in a confusing mixture of stimuli, from which they have to learn to make sense (Piaget, 1962). A large body of research contradicting Piaget's assumptions, however, made his theory collapse (Meltzoff, 1999). According to the theory-theory, described by Meltzoff, children live in a much more organised world, already from birth. The theory-theory states that children have an innate representational system (their "theories"), which, during development, changes qualitatively influenced by their experiences with the world (Meltzoff, 1999). Another very relevant theory in this regard is the intersensory redundancy theory of Bahrick and Lickliter (2000). This theory states that information that is presented redundantly and in temporal synchrony across modalities to young infants, selectively recruits attention and facilitates perceptual processing and learning more effectively than the same information that is presented unimodally. Bahrick and Lickliter vouched their theory with multiple experiments, demonstrating that 5-month-olds were capable of discriminating novel rhythms from a rhythm they had been habituated to, when the rhythm was presented bimodally (visually and auditory), but not when it was presented unimodally (Bahrick & Lickliter, 2000). They also found that 3-month-olds were capable of discriminating tempo changes when these were presented bimodally (Bahrick, Flom, & Lickliter, 2002). Intersensory redundancy facilitates the coordinated perception of multimodal events. It is related to language acquisition, with spoken language being a multimodal event wherein speech and (facial and manual) gestures are combined (Bahrick et al., 2002). This innate intertwining of speech and gestures has also been supported by numerous experiments demonstrating perception-motor links, both at neural and at behavioural levels and both related to speech, as to broader motor actions. The McGurk effect, in which a syllable is perceived differently when a viewer sees a speaker produce another syllable as the one that is presented auditory, is an example experiment that supports this theory (McGurk & MacDonald, 1976). Another example is the bounce illusion, in which two circles moving towards each other, overlapping each other and moving further away from each other, are perceived as bouncing into each other and shifting direction when a bouncing sound accompanies their presentation (Bahrick & Lickliter, 2002). Perception, imitation, and spontaneous production of speech and gestures have also been found to be superimposed on the same neural systems (Bates & Dick, 2002). An important neurological factor in this regard, is the mirror neuron system. Motor representations of oral and manual movements have been found to overlap in many frontal and parietal regions in the human brain, with the ventral premotor area being of central importance (Bates & Dick, 2002; Corballis, 2009). This area is home to Brodmann's areas 44 and 45, also known as Broca's area, a very important region for language processing. It is also home to the first discovered mirror neurons (area F5 in apes). These mirror neurons seem to play a crucial role regarding the close relationship between gestures and speech. Mirror neurons are neurons that fire when someone plans an action (e.g., performing a gesture), but also when someone sees or hears another person performing this action (both transitive and intransitive actions; Corballis, 2009, 2010). The activity of mirror neurons can cross modalities (Corballis, 2010), and they respond reliably to and are even enhanced by multisensory stimulation (Bahrick & Lickliter, 2002). Mirror neurons are thought to be important with regard to imitation, perceptual learning and action understanding, theory of mind, social communication, and language (Bates & Dick, 2002; Corballis, 2010). Persons with ASD have been found to have problems with regard to their mirror neuron system and sensory integration. In people with ID, however, such problems are not systematically encountered, but can be present mostly in relation to motor problems (Wuang, Wang, Huang, & Su, 2008).

A next important aspect is *imitation*. Children have been found capable of imitating facial expressions and speech sounds very early on. This imitation seems to depend on an active intermodal mapping process (Meltzoff, 1999). This means that imitation is a matching-to-target process, in which infants compare proprioceptive feedback with the visual target. Perception and production of movements are thought to be registered within a common supramodal representational system (Meltzoff, 1999; cf. the mirror neuron system and the intersensory redundancy theory). In other words: infants, from birth, are able to integrate sense modalities and to use this multimodal processing of information for imitation and for language learning. This makes imitation very relevant to KWS, being a multimodal combination of speech and signs (Chambers & Rehfeldt, 2003). Because acquiring manual signs is a motor learning process, it relies partly on gestural imitation skills. Carr, Pridal, and Dores (1984; in Bryen & Joyce, 1986, p.188) "have suggested that motor imitation skills might serve as a predictor of sign learning". On the other hand, poor imitators should not be excluded from KWS interventions, because they could still be capable of producing manual signs in a certain (meaningful) context (Stowers et al., 1987).

Imitation can be seen as the basis of *memory*, with young infants already performing deferred imitation of novel behaviours that they perceived (Meltzoff, 1999). Working memory has been found to play a very important role in language acquisition, both in normally developing children and children and adults with ID (Meltzoff, 1999; Numminen, Service, & Ruoppila, 2002; van der Schuit, Segers, van Balkom, & Verhoeven, 2011). Working memory refers to a cognitive system that stores and manipulates information during cognitive activities, and is usually considered to consist of three systems: the central executive system (which controls attention), the visuospatial working memory or sketchpad, and the phonological working memory or loop (Baddeley & Hitch, 1974). Related to AAC, graphic symbols are thought to be less demanding on working memory because only recognition is needed, whereas manual signs require the use of recall memory (Clibbens, 2001; van der Meer et al., 2012). Working memory for manual signs parallels that for visuospatial materials, because it has been found to store signs as visual representations (Wilson & Emmorey, 2003). Working memory for sign language, however, also parallels that for speech, in that information is stored in a phonological code (Emmorey & Wilson, 2004). Storage capacity for signs still has consistently been found to be lower than for spoken words. This is explained by signs taking longer time to articulate compared to words (Marschark & Maye, 1998; Wilson & Emmorey, 2006), and the visual system being poor with temporal coding, but superior with spatial coding (Emmorey & Wilson, 2004; Marschark & Maye, 1998; Wilson & Emmorey, 2003). The latter ensures that this difference in immediate serial recall between words and signs has no effect on more complex measures of working memory, as manual signs exploit spatial mechanisms and avoid temporal coding (Emmorey & Wilson, 2004).

Theory of mind is an important concept with regard to language acquisition as well, and is thought to be related to working memory, executive function, imitation, and nonverbal intelligence (Sundqvist & Rönnberg, 2010). Theory of mind refers to "the ability to understand the mental states of other people" (Sundqvist & Rönnberg, 2010, p. 86). It is necessary to be able to understand symbolic actions (for example gestures), because the viewer of such an action understands it in terms of how he or she would perform it, and then associates this with the meaning of the action (Corballis, 2010). Theory of mind is a prerequisite for understanding intentionality, which is necessary for communicative development (Meltzoff, 1999). It has been found to emerge at around 15 to 18 months of age in typically developing infants (Meltzoff, 1999). Theory of mind is typically distorted in children with ASD. Deaf children have been found to have problems with false-belief tasks, which are commonly used to assess theory of mind, as well. These difficulties, however, mostly found in deaf children of hearing parents, can mainly be attributed to the fact that these children lack a common language with their parents and therefor lack the conversational experience needed to learn the concept of the mental stage of others (Marscharck, Green, Hindmarsh, & Walker, 2000). Children who use AAC are also at risk for this lack of experience, however, no theory of mind difficulties were found in a group of AAC users (Sundqvist & Rönnberg, 2010).

A person's *degree of ID* is also thought to relate to language learning in general and learning and use of manual signs in particular (Marquardt, Sanchez, & Muñoz, 1999; Poulton & Algozzine, 1980). On the other hand, no minimum IQ for a person to be a candidate for KWS should or can be set. Given the complex relation between language and cognition, a lack of receptive or expressive language skills can seriously impact the cognitive development of an individual. Also, some individuals will not be able to demonstrate their cognitive skills because no communication mode is available to them until an AAC intervention is started (Romski & Sevcik, 2005). In order to use manual signs as symbols for certain concepts, *symbol awareness* seems an important skill as well (Butterfield, 1991; Luftig, 1982). However, manual signs have been successfully used with presymbolic (perlocutionary or illocutionary) communicators (Ogletree & Pierce, 2010), so symbolic awareness is certainly not a prerequisite for using KWS with a client (Bloomberg, 2005; Hubbers, 2009; Romski & Sevcik, 1997). Also, the use of a representational communication mode such as KWS with a person may promote the development of symbol awareness (Butterfield, 1991).

With regard to **language and communication** skills, the presence of communicative forerunners seems a good indication for a KWS intervention to become successful. As described above, symbolic skills are relevant, as are contingency awareness, communicative intent, and basic communicative skills such as eye contact, giving/showing, pointing, and joint attention (Bryen & Joyce, 1986; Loncke et al., 1993, 1998; Rowland & Schweigert, 2003). Clients who spontaneously use gestures and/or pantomime when attempting to communicate, are assumed to be susceptible to manual sign learning (Loncke et al., 1993, 1998; Poulton & Algozzine, 1980). Marquardt et al. (1999) found expressive and receptive language skills to be good predictors for manual sign learning in adults with ID. Lastly, the desire and will to communicate are relevant to the success of a KWS intervention (Bryen & Joyce, 1986; Luftig, 1982).

Motor skills are important for KWS users as well. It is clear that clients need to attain a certain level of voluntary movement of the upper limbs and hands to be able to produce manual signs. Also, although manual signs require fewer fine-motor skills compared with speech, some fine-motor skills remain necessary (Bryen & Joyce, 1986; Grove, 1990). Marquardt et al. (1999) found motor skills to be good predictors for sign learning in adults with ID. With regard to these motor skills, however, it is dangerous to exclude individuals from using KWS based on less well developed skills. When a person starts using manual signs, this might stimulate the development of motor skills and encourage the person to push his or her boundaries.

When discussing client characteristics in relation to AAC, it is very important not to exclude persons from AAC support based on certain less developed skills. Professionals should not define strict requirements for an individual to be eligible for a KWS intervention or not (Beukelman & Mirenda, 2005; Hourcade et al., 2004). Denying a person a specific form of communication based on certain characteristics refutes the fact that communication is a basic right for every human being (Butterfield, 1991; Ogletree & Pierce, 2010). Also, AAC interventions in general and KWS in particular appeal to skills that have often not been stimulated in the client before the intervention started. From clinical experience we know that persons can acquire certain skills they did not yet possess, e.g., fine-motor skills, once these skills become relevant in specific situations (Loncke et al., 1993, 1998; Rowland & Schweigert, 2003). With this in mind, we should avoid the term *prerequisites* and instead speak of characteristics that might influence sign learning and use, and of certain behaviours that might be positive indicators for a person to become successful in using KWS, without excluding anyone who does not (yet) exhibit these behaviours. Even if some individuals will not be capable of learning KWS for expressive communication, they still might benefit from KWS to understand their environment.

Among the population of people with ID, individuals with DS are frequently reported to be particularly proficient in gestural communication (Abbeduto et al., 2007; Chapman & Hesketh, 2001; Powell, 1999). Many studies have reported improvements in communication for children with DS who used KWS compared with children who did not use KWS (see Clibbens, 2001, for a review). In adults with DS as well, positive results with KWS have been reported (for example Marquardt et al., 1999). This susceptibility for signing can be associated with the relative strength in processing visual information often shown by people with DS (Broadly, MacDonald, & Buckley, 1995; Vicari, 2006). Individuals with DS have also been found to be particularly good imitators (Abbeduto et al., 2007; Vanvuchelen, Feys, & De Weerdt, 2011). On the other hand, individuals with DS have been found to be slower and less consistent in their formation of gestures compared with their typically developing peers (Treviranus & Roberts, 2003). The latter findings can be related to the verbal-motor integration problems of people with DS, which cause problems not only with tasks that require the organization and control of oral (speech) movements, but also of manual movements, when based on verbal direction (Elliott & Bunn, 2004). When instructions for performing gestural movements were given verbally, adults with DS had more problems compared with their typically developing peers. When visual instructional protocols were applied or when gestures were demonstrated, both children and adults with DS performed as well as, or even better than, their mental age counterparts (Elliott & Bunn, 2004).

1.3.4.3. Environmental characteristics

A final group of characteristics that are of influence on KWS acquisition and use, are characteristics of the environment. The communicative environment of an adult with ID can consist of caregivers, family and friends, and professionals like support staff, psychologists, SLP, and other therapists. The environment first of all determines which signs are taught to the KWS user (and which are not; Bryen & Joyce, 1986). Determining this KWS **vocabulary** can rely on (a) the functional relevance (communicative value) of the sign and the motivation of the client to use the sign (Bryen & Joyce, 1986; McEwen & Lloyd, 1990), and (b) the learnability of the sign, which is thought to coincide with its motor, iconic, and referential characteristics (McEwen & Lloyd, 1990). Signs should be selected for each individual separately, according to his or her needs, wants and interests. Working with fixed vocabulary lists can hinder a person in his/her communication, when he or she wants to express something which is “not on the list”. Also, research has shown that, when therapists try to predict the vocabulary needed for a certain person in a certain situation, they very often do not succeed well in doing so (e.g., for a leisure activity only 47% of the predicted vocabulary by SLP and support workers was actually used by individuals with cerebral palsy, Dark & Balandin, 2007). This highlights the major responsibility of therapists in selecting a KWS vocabulary for their clients, and encourages them to deal with vocabulary selection very thoughtfully (see for example Dice, 1994, for a review concerning this topic).

The environment also influences the use of KWS through the **knowledge of and attitude towards KWS** of the communication partners. These communication partners should always have a larger manual sign repertoire than the person with ID with whom they interact, in order for them to offer an effective sign learning model (Bryen, Goldman, & Quinlisk-Gill, 1988; Bryen & Joyce, 1986; Bryen & McGinley, 1991; Faw, Reid, Schepis, Fitzgerald, & Welty, 1981; Nozaki, Mochizuki, Yairo, & Tsunoda, 1991; Schepis et al., 1982). In fact, individuals should be immersed in a rich language learning environment in order for them to learn to use KWS functionally. This means that the communication partners of KWS users require extensive training. Also, resource materials should be readily available as sources of reference (Grove & Walker, 1990). Communication partners should keep practicing and maintaining both the manual signs and the KWS methodology, and keep broadening their vocabulary. They should also use the signs not only in isolated teaching conditions, but model KWS consequently throughout the day (Bryen & Joyce, 1986; Butterfield, 1991; Grove & Walker, 1990). Finally, the thoughts and believes concerning KWS of the environment influence KWS use (Bryen & Joyce, 1986). Negative attitudes of the environment can hinder the success of a KWS intervention.

1.3.5. Why is KWS successful?

Many people with ID, who fail to develop (intelligible) speech or who have difficulty understanding spoken language, do manage to learn to communicate with KWS (see chapter 2). Different explanations can be given for this success. A **first** explanation is that manual signs are more visual compared with spoken language. Visual information is processed dominant to auditory information in early development, and many people with ID show an explicit preference for processing visual information compared with auditory information (Bryen &

Joyce, 1986; Grove, 1980; Laws, 2002; Loncke et al., 1993, 1998; Nijs et al., 2003; related to the intersensory redundancy theory when speech and sign are combined, Bahrick & Lickliter, 2000). This also explains why manual signs, to many, are easier to teach compared with speech. Imitations that are visible to the imitator (such as a lot of signs) develop in an earlier stage than imitations that are invisible to the imitator (such as speech; Kahn, 1981). Signs that are visible to the person who performs them, provide him or her with visual feedback, in addition to proprioceptive and kinaesthetic feedback (Grove, 1980; related to the supramodal representational system, Meltzoff, 1999). When teaching signs, physical guidance can be provided as well, in that signs can be moulded and actively supported and corrected by a therapist (Bryen & Joyce, 1986; Grove, 1980; Loeding et al., 1990; Wells, 1981). Signs can also be held in place for a moment (at various points in the movement), allowing the learner to better perceive certain features such as hand shape and location (Bryen & Joyce, 1986; Grove, 1980; Loeding et al., 1990). Many signs involve rhythmic movements, which are thought to deepen the perceptual-motor traces in memory, contributing to easier memory storage of the sign (Doherty, 1985; Grove, 1980; related to the intersensory redundancy theory when combined with speech, Bahrick & Lickliter, 2000). **Second**, producing manual signs requires less developed fine-motor skills compared with speech (Loncke et al., 1993, 1998; Nijs et al., 2003). Also, neurological control of the hands matures earlier than that of the speech muscles (Grove, 1980). The gestural modality is thus easier to master than the vocal modality for many young children (Goodwyn & Acredolo, 1993). Typically developing children are already capable of using gestures communicatively at a very young age (at 8 to 11 months of age in the early-intentional phase of communicative development), before speech has developed (Acredolo & Goodwyn, 1988; Goodwyn & Acredolo, 1993; see Bates & Dick, 2002 for a review). A **third** possible explanation is that manual signs, although many signs are not transparent, are more iconic and thus thought to be more easy to acquire and remember compared with spoken words (Bryen & Joyce, 1986; Kahn, 1981; Loncke et al., 1993, 1998; Nijs et al., 2003; Wells, 1981). **Fourth**, KWS is thought to be successful because, as gestures, signs bring structure and clarification to spoken language, making it easier to process and understand (Loncke et al., 1993, 1998; Nijs et al., 2003). The most important information in the message is highlighted by the signs. Also, speech that is produced in combination with manual signs, automatically is simplified and presented at a slower rate (Windsor & Fristoe, 1991). **Finally**, the multimodality of KWS itself makes the communicative message redundant, which increases chances for an optimal transfer of the message (Loncke et al., 1993, 1996, 1998; Nijs et al., 2003; related to the intersensory redundancy theory, Bahrick & Lickliter, 2000). Because of these positive aspects of KWS, it has been used in people with ID around the world for many decennia.

1.3.6. History of manual signing and KWS

Both Socrates and Plato already described individuals with hearing impairments who used manual signs some 400 years BC. Manual sign use in individuals with hearing impairments, but also in religious communities, nomadic groups, and persons with ID, has been described in the Middle Ages as well (Jensen, 1999; Moores, 1981). In these modern times, however, the use of signs as an AAC mode has not always been considered positive (Hourcade et al., 2004; Jensen, 1999). Within deaf communities as well, signing was not tolerated until the late seventies. Sign languages were not considered as full-fledged languages, they were judged to be inferior to spoken language, and the use of signs was feared to impede language and speech development (Moores, 1981). Fortunately several studies nowadays have made clear that signing and the use of KWS do not impede communicative development, on the contrary, KWS may even stimulate the development of speech and language (Acredolo & Goodwyn, 1988; Bird, Gaskell, Babineau, & MacDonald, 2000; Chan & Iacono, 2001; Goodwyn, Acredolo, & Brown, 2000; Kahn, 1981; Millar, Light, & Schlosser, 2006; Romski & Sevcik, 2005; Schlosser & Wendt, 2008). From the 1970s, the use of manual signs as AAC became more widespread (Powell, 1999). At that time, this method was usually referred to as *total communication*, *alternative communication*, or *simultaneous communication*, terms that originated from the education of individuals with hearing impairments (Powell, 1999; Romski & Sevcik, 2003). Many authors in the 1970s and early 1980s also used the term *sign language* in connection with manual signing and people with ID and developmental disabilities, even if no real sign language was used (e.g., Bonvillian & Nelson, 1976; Linton & Singh, 1984). Indeed, most of these interventions are probably more accurately described as KWS (Beukelman & Mirenda, 2005; Fristoe & Lloyd, 1978; also see section 1.3.1), hence we will use this term throughout this document.

The first publications on the application of manual signing and KWS in individuals with developmental disabilities, were mainly case studies in children and adolescents with ASD and/or ID. These pioneering researchers were inspired by Gardner and Gardner (1969), who successfully taught about 150 manual signs to a chimpanzee. Also, many therapists experienced that teaching speech to individuals with severe ID and other developmental disabilities, as was frequently the only goal of speech and language therapy at that time, was rarely successful. If the individuals did acquire some speech, they often could not use it functionally (Bryen & Joyce, 1986; Hourcade et al., 2004). This prompted therapists of people with severe disabilities to experiment with other means of communication than speech (Jensen, 1999). The earliest publication we found was by Bricker, who in 1972 reported to have taught manual signs to 26 children with a severe ID. According to Konstantareas, Oxman, and Webster (1977), the first investigator to describe the application of KWS in a group of children with ASD was Creedon (1973, in Konstantareas et al., 1977). The goal of incorporating manual signs in these earliest studies most often was to elicit speech (Hourcade et al., 2004). Later on, some professionals "began to advocate for an increase in the use of sign language with persons who had severe disabilities, suggesting the then-revolutionary notion that sign language could be useful even for individuals with no hearing loss, and could even become the primary mode of communication for them" (Hourcade et al., 2004, p.238). From then on, increasingly more studies concerning the use of KWS in both children and adults with different communication disorders, mostly caused by ASD or ID, were published and KWS became more widespread (see chapter 2). A series of surveys for SLPs conducted in the United States (Fristoe & Lloyd, 1978; Goodman, Wilson, & Bornstein, 1978) and the United Kingdom (Jones, Reid, & Kiernan, 1982; Reid, Jones, & Kiernan, 1983) shows that manual signing and KWS were being used more and more frequently in children and adults with ID, ASD, apraxia, aphasia, cerebral palsy, and other conditions causing communication difficulties.

Among the first KWS systems that were developed for people with ID in Europe and that also became used clinically, were the *Makaton Vocabulary* in 1972 in Surrey, England (Grove & Walker, 1990), and the system *Spreken met het lichaam* (Speaking with the body) in 1975 in Sint Michielsgestel, the Netherlands (Speth & van den Hoven, 1975). Makaton was developed by SLP Margaret Walker (together with Kathy Johnston and Tony Cornforth) as a project to teach manual signs to adolescents and adults with hearing impairments and severe ID living in an institution (Grove & Walker, 1990). It is still one of the most widely used KWS systems in the United Kingdom and around the world (Grove & Walker, 1990). It consists of a core vocabulary of 350 basic signs, but can be extended to a quasi-unlimited vocabulary (with a so called "open-ended lexicon"). The target population of *Spreken met het lichaam* was similar to that of Makaton (Speth & van den Hoven, 1975), and the system consisted of 275 signs. The signs from Makaton are derived from BSL, whereas those from *Spreken met het lichaam* were developed specifically for people with ID. In the United States, already from the early years, people with ID mostly used signs from ASL with a KWS approach (Fristoe & Lloyd, 1978; Gates & Edwards, 1989; Stowers et al., 1987), although specific systems with modified signs were also developed (e.g., *Amer-Ind* based on American Indian Hand Talk, Skelly, 1979 in Campbell & Jackson, 1995; *Duffysigns* for individuals with motor difficulties, Stowers et al., 1987). In the 1980s, more KWS systems specifically designed for people with ID were created. *Lámh* is a KWS system that was developed in Ireland, and consists of 500 signs that are mainly adapted from Irish Sign Language (Lámh, 2008). In Flanders, *Spreken Met Ondersteuning van Gebaren* (SMOG, Speaking with support of signs) was developed by Loncke et al. (1998). It consists of about 500 signs which are derived from VGT, but with multiple features adapted (see section 1.3.7). Duker (1983) developed a *Gebarentaal voor ontwikkelingsgestoorden* (Sign language for the developmentally disabled). Although the author used the term *sign language*, this system can more accurately be described as a KWS system. It consists mainly of a description of the KWS methodology, a behavioural therapeutic method to teach manual signs to people with ID, and line drawings of 50 signs mainly derived from ASL. In 1984, the Weerklank signs were developed in the Netherlands (*Communiceren met gebaren* [Communicating with signs], Weerklank, 2007). The signs were based on the Amsterdam dialect form of

NGT, and a vocabulary of 400 signs was composed and displayed with photographs. This vocabulary was later extended to include 800 signs, most of them based on NGT, with some motor adaptations. In 1985, the *Johanna Stichting* (Johanna Institution) published their KWS system (*Gebaren* [Signs], 1985). The 500 signs they used were based on signs from ASL, BSL, *Gestuno* (international sign language) and *Spreken met het lichaam*. Loeding et al. (1990) described the development of a KWS program for children with ID, which consisted of 122 signs that were mainly taken from ASL, but with motor features adapted. Many other KWS systems have been developed around the world, for example *Schau doch meine Hände an* (Look at my hands) in Germany (Bober, 1994), *Coghamo* (Tytgat, s.d.) and *Sesame* (Bosteels et al., 1995, in Loncke et al., 1998) in French-speaking Belgium, and so on.

There are large differences between these sign systems, in composition, vocabulary, and in complexity. Many of the described systems nowadays are no longer in use (for example *Spreken met het lichaam* and *Communiceren met gebaren* in the Netherlands), in favour of systems that make use of signs from existing sign languages. Also, Makaton, since it originated over 40 years ago, has spread outside the United Kingdom, and local variants have been developed in Germany, France, Greece, India, Japan, and Poland, among others (Grove & Walker, 1990). The manual signs that are used in Makaton are always derived from the local sign languages. In Australia, KWSA is used, with signs derived from Australian Sign Language (Bloomberg, 2005). In Sweden, multiple terms for KWS are used (for example *tecken till tal* and *tecken som alternative och kompletterande kommunikation*), but signs are mostly adopted from *Svenska Teckenspråket* (Swedish Sign Language; Heister Trygg, 2010). In the Netherlands as well, educators and psychologists agreed to stop using special signs for people with intellectual and other developmental disabilities, and to start using signs from the (standardized) NGT with a KWS (*Weerklank*) approach instead (Hubbers, 2009).

In conclusion, many different KWS systems have been developed since the 1970s. Some of them are still in use, but others have fallen into disuse. The KWS system that is most frequently used in Flanders is *Spreken Met Ondersteuning van Gebaren*, and is discussed next.

1.3.7. Spreken Met Ondersteuning van Gebaren

1.3.7.1. What is Spreken Met Ondersteuning van Gebaren?

The Flemish KWS system that is used in this research project, is called *Spreken Met Ondersteuning van Gebaren* (SMOG, Speaking with support of signs; Loncke et al., 1998). SMOG was developed in the 1980s in Flanders, Belgium. It has since been used by and with hundreds of children and adults with a communication disability (Loncke et al., 1998). It is a restricted KWS system with a basic corpus consisting of approximately 500 signs. The signs that are used in SMOG originate from *Nederlands met Gebaren* (NmG, Dutch with signs, a Flemish educational sign system; see section 1.3.7.2) and VGT, but some phonological features (mainly hand shapes, because these are the most difficult to acquire; Doherty, 1985) have been adapted (Nijs et al., 2003). Many success stories with regard to SMOG have been told (increase in communication, a more efficient and effective communication, more developmental opportunities, increase in quality of life), but unfortunately they are poorly, if at all, documented (Nijs et al., 2003).

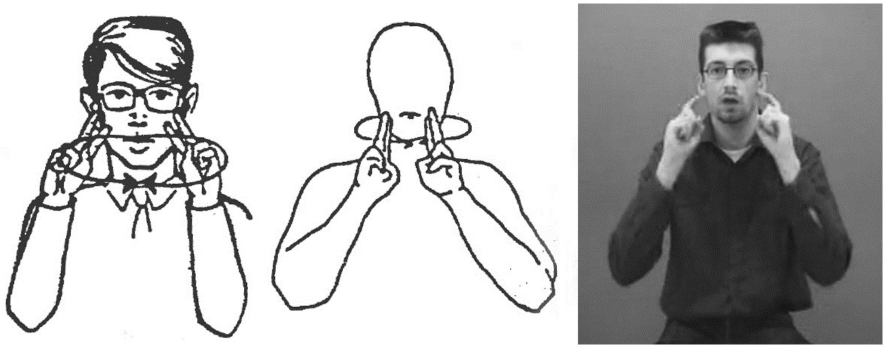

Figure 1.2. The sign CHEESE in (from left to right) NmG, SMOG, and VGT (variant with 1" hand shape; NmG and SMOG line drawings from Loncke et al., 1993; VGT video still from *Woordenboek Vlaamse Gebarentaal* [Flemish Sign Language Dictionary], 2004).

1.3.7.2. History of SMOG

SMOG was developed in 1985 and 1986 by Filip Loncke, Martine Nijs and Louis Smet (Loncke et al., 1993, 1998). The first SMOG user was a young adolescent with behavioural problems caused by communication difficulties. His SLP, Martine Nijs, in consultation with the principal of his school for special education, Louis Smet, started searching for a suitable communication form for the boy. They noticed that he was very susceptible to manual signs, and that he was capable of using them in a functional communicative way, resulting in a decrease of problem behaviour. Strengthened by this positive experience, together with neurolinguist Filip Loncke, SMOG was developed. The first SMOG corpus consisted of approximately 500 signs, based on signs of VGT and NmG, which is a manual sign system that is used in deaf education (Loncke et al., 1993, 1998). Most NmG signs correspond to those of the VGT lexicon. However, because NmG is an educational system, fingerspelling elements were added to many signs. This so called *initialisation* of the signs means that the hand shape refers to the initial letter of the spoken word. For example, the sign KAAS [cheese] in NmG is performed with a K hand shape. The authors of SMOG changed this hand shape to a H hand shape (see Appendix A for an overview of the hand shapes used in SMOG). This H hand shape is thought to be easier to perform, because it occurs earlier in the typical motor development of young children than a K hand shape (see section 1.3.4.1 and chapter 4). In VGT, however, the sign CHEESE is not performed with a K hand shape, but with a V" or 1" hand shape (see Figure 1.2). These hand shapes occur at similar times or even earlier in the typical motor development than the H hand shape. Changes that have been made to signs from NmG to develop the SMOG signs 30 years ago, may not be relevant anymore to the VGT signs from nowadays.

1.3.7.3. Specific features of SMOG

The intent of SMOG was to develop a system with a limited sign vocabulary, a high utility, a high degree of transparency, and signs that do not require a high level of psychomotor skills (Loncke et al., 1998). SMOG thus has a rather restrictive vocabulary on purpose, because the authors believed that a too extensive vocabulary is too complex for people with ID (Loncke et al., 1998; Nijs et al., 2003). The concepts for the first 500 basic signs were selected based on the *Nieuwe streeflijst woordenschat voor 6-jarigen* (Vocabulary list for 6-year olds; Kohnstamm, Schaerlaekens, & de Vries, 1981), complemented with concepts that were present in existing sign systems for people with ID (for example Makaton), and the clinical experience of the authors with the target population (Loncke et al., 1998). This basic lexicon of SMOG has frequently been re-evaluated and, if necessary, adapted to better reflect the basic communication needs of the target population in the current zeitgeist. Thus, the size of the lexicon fluctuates, but is always kept around 500 signs. At the start of this study (spring 2009), the basic SMOG vocabulary consisted of 507 signs. Many of these signs refer to broad concepts. The sign for HOUSE can for example also refer to HOME, a CASTLE, or a DOGHOUSE. The SMOG signs are perceived as having a high degree of iconicity (see chapter 4). As explained in section 1.3.7.2, the signs from SMOG are adapted from NmG and VGT, and for some signs, one or more of the phonological features have been changed in an effort to make them motorically easier to perform (see chapter 4).

Professionals can learn the SMOG signs and KWS approach in an official SMOG training, which is organised once to twice a year. During six days, the KWS background and methodology and the basic lexicon of 507 signs are taught and practiced. Professionals are expected to select a personal vocabulary from those 507 signs for their clients. When an additional sign does seem indispensable, professionals can contact the SMOG office and ask for that particular sign. If someone has asked for the sign before, it is looked up in an existing list of extra signs. If it has not been asked before, a new sign is made, usually based on a VGT sign. The signs that have been requested in addition to the basic lexicon, are all registered centrally at the SMOG office, but are not released publically (Loncke et al., 1998; Nijs et al., 2003; L. Smet, personal communication, January 2010).

The basic corpus of SMOG signs is documented with line drawings that are not publically available. The line drawings can only be obtained by professionals who attend the official SMOG training, or by parents who attend a SMOG training for parents. Video clips also exist but are not disclosed and only available to the authors (L. Smet, personal communication, January 2010). Some organisations have made their own video clips of the SMOG signs for internal use, but this is not encouraged by the authors of SMOG and those video clips often contain quite some errors (L. Smet, personal communication, January 2010). The lack of available resources for the SMOG signs is a stumbling block that is often quoted (Paelinck, 2002). Although people can understand that the authors want to protect SMOG against bastardization, the fear that this protectionism leads to unnecessary additional effort and even cessation of the implementation of SMOG is also present (Paelinck, 2002).

Literature on the use of SMOG in children and adults with ID is quite scarce and scattered. Besides in the official SMOG handbook (Loncke et al., 1998), studies on SMOG have only been reported in the context of Master's theses (e.g., Dillen, 2003; Ostach, 1999; Schreiber, 2000).

1.3.8. Conclusion

KWS is a means of AAC frequently used in adults with ID. Research has made clear that adults with ID are capable of acquiring KWS and of using it to express certain communicative functions. Little scientific evidence is available, however, concerning the functional use of KWS by adults with ID in everyday communication. Also, the Flemish KWS system SMOG, since its development, has only sporadically been studied. Therefore, in this research project, the functional use of KWS in adults with ID is explored, applied to the Flemish KWS system SMOG.

1.4. General outline of this study

1.4.1. Goals of this study

Evaluating the functional communication in adults with ID who use KWS was the main focus of this research project. This was translated into four main objectives:

Goal 1: to map the prevalence of KWS use among adults with ID and the way KWS is used by them in a survey study;

Goal 2: to evaluate the relation between sign characteristics and functional KWS use in adults with ID in a second survey study;

Goal 3: to study the relation between client characteristics of KWS users and their functional KWS use in a cross-sectional study; and

Goal 4: to examine the relation between client and environmental characteristics and KWS acquisition and functional use in an intervention study.

This research project stresses the functionality of KWS use. This, to us, seems clinically most relevant. The key question is not how many signs an adult with ID can produce in a therapy room, but how he or she can use KWS in everyday communication. We wanted to find out if KWS users can transfer their knowledge outside the therapy room and use it to express a variety of communicative functions in a natural situation. We chose to evaluate this functional KWS use in adults with ID, because we wanted to assure that KWS was used as a permanent means of communication, and not as a temporary means or to stimulate the development of spoken language.

1.4.2. Overview of methods

The medical ethical commission of the UZ Leuven Hospitals approved the methodology of this study.

1.4.2.1. Goal 1: Prevalence of KWS among adults with ID

The prevalence of KWS use in Flanders was evaluated in a mixed mode survey design. Because little to no information concerning the use of KWS in Flanders was available, we started with a telephone survey in which all 347 day care and residential service programs in Flanders were contacted. If the program met the inclusion criterion (their clients needed to be adults with ID; n = 297), we asked to speak with the person responsible for communication in the program (usually a psychologist, SLP, or support worker,). This person was asked if KWS was used with one or more of their clients, and if so (n = 152), if he or she was willing to fill out a questionnaire concerning this KWS use. This questionnaire was developed specifically for this study, and evaluated in a focus group of experienced SLPs. It questioned how many clients used KWS, what their characteristics were (level of ID, additional disabilities, and so on), and how many signs they used. The sign use of support staff of the program was also questioned. The communication supervisors of 142 programs agreed to cooperate further, and questionnaires were returned by 93 of them. These participants were asked if they wanted to fill out a second, more detailed questionnaire for their clients who used KWS. This second questionnaire was used for the next objective of this study.

1.4.2.2. Goal 2: Relation between sign characteristics and functional use of KWS

The relation between sign characteristics and the functional use of KWS in adults with ID was evaluated in a survey study. In order to do so, first, the characteristics of the 507 basic signs of the Flemish KWS system needed to be determined. The phonology of each of the signs was characterized based on a phonological sign model used in VGT and NGT (Demey, 2005). The iconicity of the signs was determined in a group of 467 students, 199 of whom were asked to guess the meaning of the signs (i.e., the transparency of the signs) and 268 of whom were asked to rate how well they found the signs represented their referent (i.e., the translucency of the signs). The referential characteristics were determined using a linguistic database for concreteness (Wilson, 1988), mutual agreement by five SLPs for semantic category, and a dictionary for grammatical class (Van Dale, 2008). The functional sign use of 119 adult KWS users with ID was evaluated with a questionnaire. These adults were recruited among the participants of the first survey study (see section 1.4.2.1). A questionnaire was used in an effort to gather a variety of information in a noninvasive way, concerning a large group of individuals. This questionnaire, to be filled out individually for one KWS user by a support worker very familiar with this KWS user, consisted of a list of the 507 basic signs of the Flemish KWS system. The respondent was asked to indicate all signs the KWS user could produce independently during functional communication (analogous to the *N-CDIs*; Zink & Lejaegere, 2002). The sign characteristics and these measures of functional sign use were then related in a generalized linear model.

1.4.2.3. Goal 3: Relation between client characteristics and functional use of KWS

A cross-sectional observational study was carried out to evaluate the relation between client characteristics and the functional use of KWS by adults with ID. The client characteristics that were taken into account were the cognition and language and communication skills of the participants. Motor skills and imitation were evaluated in the next, and final objective (see section 1.4.2.4). In this third study, 40 of the 119 adults with ID for whom the second questionnaire was filled out were assessed with a test battery of language and communication tests. Inclusion criteria were: being an adult (> 18 years of age) with a congenital ID and using KWS actively (using KWS for a minimum of 12 months and a minimum active knowledge of 10 signs, as reported by support staff). Exclusion criteria were: having an uncorrected visual or auditory impairment, having an ID caused by a traumatic brain injury, and having dementia. There were 19 male and 21 female participants, with a mean age of 38.71 years (SD = 9.65). Their mean mental age, retrieved from their personal files and based on the most recent IQ test available, was 57.57 months (SD = 15.60). The aetiology of their ID was DS in 52.50% (n = 21) of the participants. Their receptive vocabulary skills were tested with the Peabody Picture Vocabulary Test (PPVT III-NL; Dunn & Dunn, 2005). Language and communication skills in general were assessed with the CPZ (*CommunicatieProfiel*-Z, Communication Profile-Z; Willems & Verpoorten, 1996), the only Dutch test adapted for adolescents and adults with ID. The ComFor test was used to assess level of sensemaking, an important preverbal communication skill (Verpoorten, Noens, & van Berckelaer-Onnes, 2004). The functional KWS use of the participating adults was observed in two situations. First, a narrative task was performed. This story retelling task with picture support was designed specifically for this research project. Second, the KWS user participated in a conversation of 15 minutes with the researcher. These two communicative situations were filmed with two cameras, one directed towards the KWS user and one towards the researcher or support worker. Functional KWS use was analysed in terms of verbal and manual signing behaviour. Measures of content (for example use of communicative functions), length (for example mean length of utterance, MLU), and semantic diversity (for example number of different signs used) were calculated. These functional KWS measures were then related to the client characteristics using Pearson's and Spearman's correlation coefficients.

1.4.2.4. Goal 4: Relation between client and environmental characteristics and acquisition and functional use of KWS

The final part of this research project was an intervention study. KWS was taught to 15 adults with ID who did not use KWS prior to the study. A one group pretest-posttest design was applied. KWS was introduced in the residence or day care centre of which the 15 participating adults made use, all within the same service provider. The adults were selected by their psychologist and support workers, because they experienced communication problems and needed a means of AAC. KWS was not yet used with any of the clients of this service provider. The only inclusion criterion for the participants was being an adult (> 18 years of age) with a congenital ID. Exclusion criteria were: having an uncorrected visual or auditory impairment, having an ID caused by a traumatic brain injury, and having dementia. Six women and nine men participated, with a mean age of 51.07 years (*SD* = 11.56) and a mean IQ of 42.80 (*SD* = 12.87). The psychologist and seven support workers who supported these adults were appointed as KWS ambassadors and were taught a basic set of 100 signs and the KWS methodology. The 100 signs were based on the outcome of the second study of this research project, and were the 100 most used signs. The KWS training program was developed specifically for this study, and consisted of workshops, photographic material and video material, and a "sign of the week" approach. In four workshops, the 100 signs were taught using written and verbal instructions, modelling, practice, and verbal feedback, supplemented with video feedback. The KWS methodology was taught both in theory and in practice, and role play and conversations were used to train the application of the KWS technique. Support staff was also taught how to teach manual signs to their clients. KWS was then introduced in the day care centre and residential groups gradually, with a rate of two signs a week, during one year. The 15 adults were assessed prior to the introduction of KWS, with a similar assessment procedure than that used in the observational study. In addition to language and communication skills (using the PPVT III-NL, ComFor, and CPZ), the imitation and motor skills of the participants were evaluated as well. For this purpose we used the Preschool Imitation and Praxis Scale (PIPS; Vanvuchelen, 2006) and a subtest of the revised Neurological Examination for Subtle Signs (NESS; Denckla, 1984). The functional KWS use of the participating adults was evaluated in a narrative task (the same task as that used for the third goal of this study, see section 1.4.2.3) and during a conversation of 5 minutes between the adult with ID and his or her support worker. The KWS use of the support staff was also evaluated during these conversations. Functional KWS use was evaluated in terms of verbal and manual signing behaviours, and both measures of length (for example number of manual sign utterances produced) and measures of semantic diversity (for example number of different words produced) were calculated. Wilcoxon signed ranks tests were used to evaluate differences in KWS use before and after the intervention, and individual results of both support workers and clients were discussed qualitatively in relation to their characteristics.

1.4.3. Thesis outline

Each chapter of this thesis describes one of the four main goals of this study. In addition, a narrative review of the literature concerning the use of KWS in adults with ID is given. This review is described in chapter **two**.

In chapter **three**, covering the first goal of this research project, the prevalence of KWS use among adults with ID in Flanders is explored. The results of a broad questionnaire, covering all residential and day care service providers for adults with ID in Flanders, are reported.

Chapter **four** of this thesis addresses the second research goal, and describes the motor, iconic and conceptual analysis of the 507 basic signs of the Flemish KWS system SMOG. These sign characteristics are then related to the functional sign use of 115 adults with ID, as evaluated with a questionnaire.

In chapter **five**, the third goal of this research project is covered. The cognition and communication and language skills of 40 adults with ID are related to their functional KWS use. The latter is evaluated in a narrative task and during conversation.

Chapter **six**, which addresses the fourth and final research goal, reports the results of the introduction of KWS in a residential and day care service provider for adults with ID. The functional KWS use of 15 clients before and after the intervention, is qualitatively discussed in relation to their client characteristics (cognition, language and communication, imitation, and motor skills). The KWS use of their environment, namely their support staff, is evaluated as well.

In chapter **seven**, a general discussion of this research project is presented. This chapter is concluded with some suggestions for future research.

Chapter 2

Key word signing in adults with intellectual disability: a narrative review

Abstract

The use of key word signing (KWS) in adults with intellectual disability (ID) has been studied since the 1970s. Finding clear evidence that supports the application of KWS in this population, is a daunting task. Literature concerning this topic is scattered and vague. The aim of this narrative review is to give an overview of the literature on the use of KWS in adults with ID between 1980 and 2013. Sources that were used include the databases Web of Science, PubMed, and Ovid (with the inclusion of Psychinfo, Eric, and Medline). Only studies that reported original research involving adults with ID, concerning the evaluation of teaching and/or functional use of manual signs/KWS, and that were published between 1980 and 2013, were included. The results of this review show that most evidence points towards the fact that KWS can be taught successfully to adults with ID for labelling and for manding. Other communicative functions are rarely mentioned, and most studies only evaluate the teaching of small sets of manual signs to small groups of adults with ID in experimental conditions. The need for studies that examine the functional use of KWS in larger groups of adults with ID within their natural environment is manifest.

2.1. Introduction

Key word signing (KWS) is an augmentative and alternative communication (AAC) method that is frequently used in adults with intellectual disability (ID). It is an unaided form of AAC, in which the key words in a spoken sentence are simultaneously supported by manual signs (Powell & Clibbens, 1994). KWS can be used temporarily or permanently, both by children and adults with various communication problems. It can support them in expressive and receptive communication. When adults with ID use KWS, it has most often become a permanent means of communication for them. KWS has been used in individuals with ID for more than 40 years, and reports on this KWS use have been published since the 1970s. The aim of this study is to provide an overview of the literature concerning the use of KWS in adults with ID. Reviewing this literature, however, is a challenging task.

A first stumbling block is the terminology that is used. KWS is a term that is not often used in literature, although it covers most of the described methods that apply manual signs in adults with ID (Beukelman & Mirenda, 2005). The majority of authors describe their interventions that involve manual signs in individuals with ID as manual signing, simultaneous communication, or sign language. These terms however, entail a lack of information or are even incorrect. The term *manual signing* for example, does not give any information concerning the way the person with ID and his or her communication partners use signs. Do they use signs in isolation, or combined with spoken language? Which concepts are signed? *Simultaneous communication* does imply that speech and manual signs are combined, but still does not indicate which parts of the spoken sentence are supported by a manual sign. *Sign languages* on the other hand, are full-fledged languages that rely solely on manual signs and body signals, and are seldom used with individuals with ID because of their semantic and grammatical complexity. KWS is a more precise term and indicates that speech and manual signs are combined, and that only the words that carry most meaning in the spoken sentence, are expressed with a manual sign as well. Most authors thus use terms which cover a broader concept than KWS, even if they actually describe a KWS technique, or erroneously use the term sign language, when in fact they use manual signs combined with speech. Many authors do not accurately describe the precise method used in the communication process between the environment and the persons with ID, and focus mainly on the acquisition of isolated manual signs, not on the actual functional use of them.

Another confusing aspect of the literature concerning KWS is the, often very poor, description of the participants. This issue has also been described by Pennington, Marshall and Goldbart (2007) in relation to AAC research in general. The term ID has not been in use for that long (American Association on Intellectual and Developmental Disabilities [AAIDD], 2008), and a great variety of other terms, such as mental retardation, mental disorders, learning disabilities (in the United Kingdom) but also nonspeakers, nonverbal people, severely disturbed people, and so on, has been used. Often, it is not clear what disability the participants of the study had exactly, making it hard to compare outcomes across studies. Also, diagnostic criteria nowadays are quite different than those used earlier, when for example the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 2005) was used to determine IQ scores for clients (e.g., VanBiervliet, 1977). These different approaches of participants complicate the interpretation of the literature.

Finally, it is difficult to get a clear overview of the KWS literature because of the many different manual signs that are being used around the world. Because these different manual signs possess very different sign characteristics, outcomes can be hard to interpret. Also, many studies, particularly in the early years, do not provide information concerning the manual signs they used, and how (or if) these signs were used in a KWS approach.

The earliest literature concerning manual signing in general and KWS more specifically, has been reviewed by Poulton and Algozzine in 1980. At that time, manual signing was trending in communication rehabilitation for individuals with ID. Poulton and Algozzine reviewed the literature from 1969 to 1979, and included all publications in which manual signs were used in an experimental study or clinical report with individuals with ID that were not deaf or blind and did not have autism spectrum disorders (ASD). They identified 19 publications, published between 1971 and 1979, mostly clinical studies or reports (n = 14). Poulton and Algozzine concluded that KWS was used in individuals of all ages and degrees of ID, with the majority of the described individuals having a severe ID. The publications that were reviewed often did not mention the type of manual signing system used (7 of the 19 included studies), but those that were reported, included Signed English, Amer-Ind, and American Sign Language (ASL). The description of the methodology used, however, revealed that all studies seemed to use a KWS approach. Authors reported that they used "total communication", "simultaneous mime and English", "signs taught with words", or "signs paired with verbal labels" (Poulton & Algozzine, 1980, p. 147-148) and in most studies, only nouns were supported with manual signs. The only communicative function that was examined in the majority of the studies, was (receptive and expressive) naming (labelling), and mostly pictures and/or objects were used in training. In most studies (*n* = 15), KWS was applied only during training periods, whereas in the remaining four studies KWS was offered to the participants throughout the day in their natural environment. Only one study, a case study of a 13-year-old boy (Brookner & Murphy, 1975, in Poulton & Algozzine, 1980) reported that functional communication was attained with the use of KWS. Besides measuring whether or not manual signs had been learned to label objects or pictures, many studies also included speech and articulation as outcome measures, although mainly poorly reported. Conclusions included that KWS could be taught to individuals with ID for labelling, that KWS approaches were more successful compared with oral approaches, that speech reception and production increased after a KWS intervention, and that frustration and behavioural problems decreased. However, most studies were poorly described, had very few participants (14 publications had fewer than 10 participants), and a meagre methodology (no baseline measures, no exact results reported, conclusions based on impressions rather than on outcome measures, and so on).

As is clear from this first review concerning the use of KWS in individuals with ID, early literature regarding this topic was often vague and imprecise. In this review study, we wanted to explore the literature that followed these early publications. Specifically, the aim of this narrative review was to give an overview of the literature concerning research studies in which manual signs or KWS were taught to adults with ID, or in which the functional KWS use of adults with ID was evaluated in natural communication.

2.2. Methods

Because of many obscurities concerning participants and methodology, a narrative review seemed the best methodology to tackle the literature concerning the use of KWS in adults with ID. We conducted a comprehensive search of the English language literature published between 1980 and 2013, using a combination of electronic and hand searches. Because the literature before 1980 has been thoroughly reviewed by Poulton and Algozzine (1980), we decided to start in 1980. The inclusion criteria for this review were: (a) studies published between 1980 and 2013, (b) involving adults (= 18 years of age or older) with an ID, (c) covering the evaluation of teaching and/or functional use of manual signs and/or KWS. We excluded studies that (a) involved adults with acquired cognitive disabilities, (b) involved adults with autism spectrum disorders, and (c) only covered the use of (presymbolic) gestures. Studies in which most participants were children, with only one or two of them aged 18 or older, were also excluded as were studies in which no clear methodology or results were reported. The literature search was conducted in the databases Web of Science, PubMed, and Ovid (with the inclusion of Psychinfo, Eric, and Medline, among others). The key words that were used were combinations of: *key word signing*, *manual signing*, *sign language*, *manual communication*, *adults*, and *intellectual disability*, *mental retardation*, and *learning disability*. The Medical Subject Headings (MeSH) *mental disorders*, *adults,* and *manual communication* were used in PubMed. Hand searches of the references in found articles were conducted as well, to maximize the chances to include a representative corpus of literature.

For reporting this narrative review, we consulted the PRISMA Statement, which aims at helping authors to report systematic reviews (Moher, Liberati, Tetzlaff, & Altman, 2009). As this is a narrative review, the PRISMA Statement was not always applicable. For example, we did not report effect sizes or confidence intervals for the included studies, as there were large differences in research questions among the studies, and as many of the included studies did not report this information. Also, the PRISMA Statement recommends using PICOS to specify study characteristics. Schlosser, Koul, and Costello (2007), however, suggested using the PESICO-template for describing the process of an AAC procedure. In PESICO, P stands for person/problem, E for environments, S for stakeholders, I for intervention, C for comparison and O for outcome. We took into account the PESICO-template to report the included studies (see Table 2.1). First, the reference of each study is given. Next, the goal of each included study is described. Under "participants", both the P (person), E (environments), and S (stakeholders) of the PESICO-template are described. With regard to the persons, we included (if mentioned in the described study): age, sensory, cognitive, and communication status, and history of AAC use (as suggested by Schlosser et al., 2007). Environments and stakeholders relate to support staff or other communication partners, if relevant. The intervention is described under "method". As not all studies involve an intervention, we decided to use the latter term. Comparisons are described under "independent variables" and outcomes under "dependent variables". Finally, the results of each included study are summarized.

2.3. Results

Based on title and abstract, a total of 115 publications that could possibly meet the inclusion criteria were found. The full text of these publications was retrieved and read. The full text of three publications could not be obtained in libraries of Belgium, the Netherlands or Germany, so these publications were not included. After exclusion of all publications that considered children, individuals with acquired disabilities or ASD, or typically developing individuals, and all publications that did not report the results of an experimental or clinical study (such as theoretical expositions, e.g., Moores, 1981; or reviews, e.g., Grove, 1990), 18 relevant publications remained. An overview of these 18 publications can be found in Table 2.1.

As can be seen in Table 2.1, most of the included studies were published in the early 1990s (n = 8), four in the early 1980s, and the remaining six between 1999 and 2008.

Table 2.1. Narrative review of literature concerning KWS in adults with ID (part 1 of 5).

Study	Goal	Participants	Method
Faw, Reid, Schepis, Fitzgerald, & Welty, 1981.	For direct care staff to teach manual signs to adolescents with a profound ID.	First experiment: Six direct care staff of six adolescents (age 16 to 22 years) with a profound ID (IQ 11 to 22) with limited to no speech. Second experiment: Same direct care staff, four of the six adolescents.	First experiment: Nine manual signs (not specified from which sign system) were taught in group training using verbal instructions, physical guidance, moulding, contingent reinforcement, and feedback (verbal and with an edible treat). Pictures of objects were used as stimuli. Second experiment: Idem but with real objects as stimuli.
Wells, 1981.	To investigate the effect of KWS compared with traditional speech training on word articulation in adults with ID in an alternating treatment design.	Three adults (age 18 to 26 years) with a severe to profound ID (IQ 24 to 33), and 15 student SLP raters.	The participants received traditional speech training (oral-motor exercise and vocal imitation) for eight words and a "total communication" (KWS) training for another eight words, using manual signs (from ASL). Trainings lasted 30 minutes, of which 15 were spent on speech training and 15 on KWS training.
Schepis, Reid, Fitzgerald, Faw, van den Pol, & Welty, 1982.	For direct care staff to teach manual signs to adolescents with a profound ID using modified incidental teaching strategies.	Fifteen direct care staff of five adolescents (age 18 to 21 years) with profound ID (IQ < 25) with limited to no speech.	Direct care staff used incidental teaching strategies (rearranging environment to prompt signing, altering routine to prompt signing, mini-training sessions, modelling of the manual signs throughout the day) to teach 17 manual signs (not specified from which sign system).
Linton & Singh, 1984.	To teach manual signs to adults with ID using positive practice overcorrection with or without positive reinforcement in an alternating treatment design.	Four adults (age 18 to 67 years) with ID (IQ 17 to 54).	The participants were taught 10 manual signs combined with spoken words (KWS, not specified which sign system). In the positive practice overcorrection condition, participants needed to repeat the manual sign correctly five times upon making an error (five signs). When positive reinforcement was added, a correct response was reinforced (five signs). Another five signs were not trained (control condition).

Independent variable(s)	Outcome variable(s)	Results
Manual sign belonging to the trained signs group (9 signs of food and drinks) or to the control signs group (the 3 signs for water, toy and soap). Sign production before and after training and at follow-up.	First experiment: Formal assessment of productive signing (naming a picture) and observation of signing and vocalizing on the living unit during leisure and supper time. Second experiment: Only formal assessment.	First experiment: Participants produced at least 63% more correct signs during formal assessment compared with before training, but no increase in signing or vocalising on the living unit was found. No increase in sign production for the control signs group was found. Second experiment: Participants produced a mean of 84% correct signs, and maintained the signing skills during 39 to 49 weeks follow-up.
KWS training versus traditional speech training. Ratings before and after the training.	Articulation ratings (on a 5-point scale) of recordings of articulation attempts before and after training.	A greater improvement in articulation ratings was found after KWS training compared with speech training for all participants and all words.
Sign production before and after training and at follow-up.	Observations of signing and vocalizations on the living unit at four different time periods during the day.	Significant increases in signing were found for all participants, and were maintained during follow-up at 5 and 17 weeks. Occurrence of vocalizations was highly variable.
Positive practice overcorrection training without versus with positive reinforcement, control condition without training.	Manual sign and vocal production upon request.	All participants learned new signs during both conditions, but positive reinforcement was superior for three participants. Two of them learned to vocalize all words correctly. The procedures resulted in equal results for the fourth participants. No manual signs were learned during the control condition.

Table 2.1. Narrative review of literature concerning KWS in adults with ID (part 2 of 5).

Study	**Goal**	**Participants**	**Method**
Sundberg & Sundberg, 1990.	To teach adults with ID to label objects using a symbol or a manual sign, and to identify objects when presented the spoken name of the object.	Four adults (age 33 to 50 years) with mild to moderate ID.	The participants were taught to point to a symbol (= selection-based behaviour) or produce a manual sign (= topography-based behaviour) when shown an object and when the object was named. Six to nine nonsense objects, names, symbols and manual signs were used.
Bryen & McGinley, 1991.	To evaluate the manual sign knowledge and use of adults with ID and their support staff.	Seventeen adults (age 29 to 58 years) with mild to profound ID who had been learning manual signs for a mean of 3.19 years, and 11 of their direct care staff.	Sign knowledge of the adults with ID and their support staff was evaluated using a questionnaire. Frequency and context in which manual signs were used were evaluated by observing two 15-minute staff-client interactions in the residence. The KWS system used was not specified.
Duker & van Lent, 1991.	To teach adults with ID to use a larger proportion of their manual sign vocabulary for spontaneous requests.	Six adolescents (age 12 to 30 years) with a severe to profound ID.	The participants spontaneously used 6 to 14 manual signs (not specified from which sign system) to request an activity. During training sessions, manual sign production of less frequently produced signs was reinforced, but production of frequently produced signs not.
Nozaki, Mochizuki, Yairo, & Tsunoda, 1991.	To teach a sign vocabulary to deaf and hearing adults with ID.	Four deaf adults (age 20 to 34 years) with ID (IQ 38 to 68) and six hearing adults (age 25 to 40 years) with ID (IQ 34 to 45).	Nineteen manual signs (adapted from Japanese Sign Language) were taught using combinations of sign language lessons, a book, posters, and review lessons.

Independent variable(s)	Outcome variable(s)	Results
The use of symbols versus manual signs.	Labelling the objects using a symbol or a manual sign; the relation between the objects and the spoken names of those objects: pointing to the correct object (one of three) for a given name.	Fewer training trials were required for mastering manual sign labelling of the objects. Three of the four participants acquired the relation between the objects and their spoken names more quickly with the manual signs compared with the symbols.
	Number of signs imitated and spontaneously produced by adults with ID, number of signs known by support staff (as reported in questionnaire), number of sign utterances produced by staff during observations, among others.	The adults with ID were reported to imitate a mean of 16.47 signs and to spontaneously produce a mean of 20.12 signs (and these measures were correlated significantly with the number of years signs were learned). Seven of them however were reported not to imitate or produce any signs. Staff reported to know a mean of 23 signs (and this number correlated significantly with the number of signs imitated by their clients). Staff only used a mean of 1.77 sign utterances during the 30 minutes of observation.
	The variability in manual signs used to spontaneously request an activity, was recorded.	The participants used a larger variation of manual signs after the training.
Type of procedure to teach the signs. Sign production before and after training and at follow-up.	Formal assessment of productive signing (naming a picture) and receptive signing (label video clip of sign produced by adult with ID verbally or by pointing at picture). Monitoring sign use in natural settings during 10 months.	All hearing adults with ID learned to produce and comprehend the 19 manual signs. They also used the signs in natural settings. Results for the deaf participants were less clear, although three out of four did learn to produce signs gradually.

Table 2.1. Narrative review of literature concerning KWS in adults with ID (part 3 of 5).

Study	Goal	Participants	Method
Wraikat, Sundberg, & Michael, 1991.	To teach adults with ID to label objects by pointing to a symbol or by producing a manual sign, and to identify objects when presented the spoken name of the object.	Seven adults (age 26 to 50) with mild to profound ID.	The participants were taught to point to a symbol (= selection-based behaviour) or produce a manual sign (= topography-based behaviour) when shown and object and when the object was named. Four to six nonsense objects, names, symbols and manual signs were used.
Schuebel & Lalli, 1992.	To teach three manual signs to an adult with ID using modified incidental teaching strategies.	One adult (age 39) with ID.	Three manual signs (not specified from which sign system) were taught with an incidental learning strategies (modelling, verbal prompts, physical guidance, positive reinforcement and naturally occurring reinforcers) with most-to-least prompt procedure (physical and verbal, only physical, only verbal, and independent initiation).
Duker, Dortmans, & Lodder, 1993.	To teach adults with ID to use manual signs for manding.	Five adults (age 14 to 31) with severe to profound ID, with sign vocabularies of 7 to 14 manual signs.	Participants were taught to accept the objects they requested using manual signs (not specified from which sign system), and to reject objects that were offered but that were not requested, using reinforcement, interruption, physical guidance, verbal instruction, and repetition.
Powell & Clibbens, 1994.	To evaluate if the speech intelligibility of adults with ID improves when they use KWS in spontaneous speech production.	Four adults (age 24 to 37, mean age 34.4), with ID, 2 "good" and 2 "poor" speakers; and four raters (1 SLP with sign knowledge, 1 SLP without sign knowledge, 2 naive listeners).	The adults were filmed during spontaneous conversation, using KWS (not specified which sign system was used) or not. Single words and phrases were edited out and presented to the raters: without them seeing the speakers and with them seeing the speakers.
Marquardt, Sanchez, & Muñoz, 1999.	To teach a sign vocabulary from Amer-Ind or ASL to adults with ID and to evaluate the relation of sign characteristics and subject characteristics on sign learning.	Ten adults (age 30 to 57) with a moderate to severe ID.	Five adults were taught 20 manual signs from Amer-Ind, five adults were taught the 20 corresponding ASL signs, during 20 sessions of 30 minutes. Language and motor skills of the participants were evaluated before training.

Independent variable(s)	Outcome variable(s)	Results
The use of symbols versus manual signs.	Labelling the objects using a symbol or a manual sign; the relation between the objects and the spoken names of those objects: pointing to the correct object (one of three) for a given name.	Fewer training trials were required for mastering manual sign labelling of the objects. All participants acquired the relation between the objects and their spoken names more quickly with the manual signs compared with the symbols.
Sign production before and after training and at follow-up.	The level of prompt required to produce a manual sign.	The participant learned to independently produce the three target signs, and maintained this skill during seven follow-up sessions at 30-day intervals.
Rejection of unrequested objects before and after training.	The rejection of unrequested objects.	The participants succeeded in learning to reject unrequested objects.
Speech samples: - of good and poor speakers; - using KWS or not; - only hearing the speaker or hearing and viewing the speaker. Raters being "skilled" (SLP) or naive.	Ratings of intelligibility on a 5-point scale.	All subjects were always assigned a higher intelligibility rate when they used KWS compared with when they did not, in all conditions (both good and poor speakers, when raters could see the speakers but also when they did not see them, both SLP and naive listeners).
Sign characteristics: iconicity and motor complexity; subject characteristics: language and motor skills.	Sign recognition (pointing to the correct of five pictures when a sign is shown), imitation (producing the sign when it is modelled) and retrieval (producing the sign upon verbal request).	No statistical differences were found in sign learning between the Amer-Ind and the ASL group, although the Amer-Ind group did perform better than the ASL group. Significant correlations were found between language and motor skills and sign learning performance.

Table 2.1. Narrative review of literature concerning KWS in adults with ID (part 4 of 5).

Study	**Goal**	**Participants**	**Method**
Palmer, Collins, & Schuster, 1999.	To teach sign receptive skills to adults with ID using a simultaneous prompting procedure.	Three adults (age 29 to 49) with a mild ID (IQ 56 to 62).	Six manual signs (not specified from which sign system) combined with spoken words, together with other nontargeted signs, were taught receptively to the participants using a simultaneous prompting procedure (verbal and physical modelling), in group sessions.
Roark, Collins, Hemmeter, & Kleinert, 2002.	To teach manual signs as nontargeted behaviour when teaching adolescents with ID to receptively identify food items using a constant time delay procedure	Four adolescents (age 17 to 19) with a moderate to severe ID.	Receptive identification of nine items of packaged food was taught to the participants using a constant time delay procedure. Manual signs for the items were also offered (KWS approach, but not specified from which sign system).
Chambers & Rehfeldt, 2003.	To teach manual signs and P.E.C.S. to mand for four reinforcing items to adults with ID in an alternating treatment design.	Four adults (age 19 to 40) with a profound ID (IQ 18 to 27).	Training was conducted at least three days per week in 30 minute sessions, half of each sessions was allocated for P.E.C.S. and half for manual signing. Four signs were taught, they were simplifications of ASL signs.
Elias, Goyos, Saunders, & Saunders, 2008.	To teach manual signs to deaf and hearing adults with ID through an automated matching-to-sample procedure.	Seven adults (age 21 to 61) with a mild to severe ID, four of which with a hearing impairment.	Relations were taught between receptive manual signs (from ASL) and pictures, and between printed words and pictures, via an automated matching-to-sample procedure (a stimulus and three possible to-match stimuli were presented, of which the participant needed to select one). Three sets of 9 item sets (signs, pictures and printed words) were used for each participant.

Independent variable(s)	Outcome variable(s)	Results
Labelling before and after training.	Labelling the manual signs verbally.	All subjects learned to verbally label the taught manual signs and showed an increase in the ability to label nontargeted signs as well.
Identifying food items before and after training.	Receptively identifying a food item; producing the manual sign for a food item.	All participants demonstrated an increase in receptively identifying the trained packaged food items. Three of the 4 participants also spontaneously produced the manual signs for the food items.
P.E.C.S. versus manual signing.	Manding for the four reinforcing items during training sessions and at the residence (generalisation).	Three of the 4 participants acquired manding using P.E.C.S. first and demonstrated generalisation of this skill in another setting. Two of them later acquired manding using manual signs as well, also showing generalisation. Participants were more likely to mand for items not present using P.E.C.S. than using manual signs.
Expressive signing before and after training.	The relation between receptive manual signs and printed words was tested using the same automated matching-to-sample procedure. The relation between pictures and expressive manual signing, and between printed words and expressive signing, were tested by asking the participants to produce the sign upon rending the stimulus.	The presentation of manual sign via matching-to-sample training was sufficient for the emergence of expressive signing for some of the participants and for some signs. Percentage correct responses varied between 100 and 0%.

Table 2.1. Narrative review of literature concerning KWS in adults with ID (part 5 of 5).

Study	**Goal**	**Participants**	**Method**
Ziomek & Rehfeldt, 2008.	To teach adults with ID mands for preferred items, and for items needed to complete a chained task, using P.E.C.S. and manual signs in an alternating treatment design.	Three adults (age 42 to 52) with a mild to profound ID.	An alternating treatment design was used to teach the three participants to mand for five preferred items and one of the three participants to mand for three items needed to complete a chained task, using P.E.C.S. or manual signs (adapted from ASL).

Note. ID = intellectual disability, SLP = speech-language pathologist, KWS = key word signing, ASL =

Independent variable(s)	Outcome variable(s)	Results
Using P.E.C.S. versus manual signs.	Manding for preferred items and manding for items needed to complete a chained task. Untrained labelling of items and using P.E.C.S. or a manual sign to name an item when a description of the item is given ("intraverbals").	Two participants learned to mand for preferred items using P.E.C.S., and showed generalization across communication partners and settings. Manual sign training was not completed in any participant. One participant also used P.E.C.S. for labelling items, and one for intraverbals. The participant who was trained in manding for items needed to complete a chained task, succeeded in doing so but did not learn to label or respond to intraverbals.

American Sign Language, P.E.C.S. = picture exchange communication system.

The majority of the studies were conducted in the United States (*n* = 13). Other locations include New Zealand (Linton & Singh, 1984), the Netherlands (Duker & van Lent, 1991; Duker, Dortmans, & Lodder, 1993), Japan (Nozaki, Mochizuki, Yairo, & Tsunoda, 1991), and the United Kingdom (Powell & Clibbens, 1994). The participants of the 18 included studies had all possible degrees of ID. In six publications, they were described as having a severe to profound ID, five studies included adults with a mild to profound ID, three with a mild to moderate ID and another three with a moderate to severe ID. The remaining two studies did not give information concerning the degree of ID of their participants. The type of manual signs that were used, most often was not mentioned (*n* = 10). Most studies that did include information concerning the applied sign system, used ASL signs (*n* = 5; one study compared ASL to Amer-Ind signs). Nonsense signs were used in two studies, and signs from Japanese Sign Language in one.

The goal of the majority of the included studies was to teach a small selection of manual signs to adults with ID in structured training sessions, and to evaluate the best method in doing so (*n* = 15). Most of these experimental studies were unclear concerning the methodology used in the communication offered towards the participants. Five of these fifteen publications stated explicitly that manual signs were combined with spoken words. In two other studies, nonsense signs were used in connection with nonsense verbal labels for objects. The remaining eight studies were unclear about which manual signing approach has been used. Communication between the participants and their environment, indeed, was not the main focus of these studies. The authors were mainly interested in teaching isolated manual signs to adults with ID in a controlled, experimental condition. Still, we can assume that the majority of these studies relate to a KWS approach, because they involved adults with ID who made use of residential services, and we assume that their support staff, besides manual signs, also used verbal language towards them.

Most of the 15 experimental studies aimed at evaluating different behavioural therapeutic methods in teaching manual signs to adults with ID (*n* = 9). These behavioural techniques include positive practice overcorrection with or without positive reinforcement (Linton & Singh, 1984), other reinforcement strategies (Duker & van Lent, 1991; Duker, Dortmans, & Lodder, 1993), modified incidental teaching strategies (Schuebel & Lalli, 1992), a simultaneous prompting procedure (Palmer, Collins, & Schuster, 1999), a constant time delay procedure (Roark, Collins, Hemmeter, & Kleinert, 2002), and an automated matching-to-sample procedure (Elias, Goyos, Saunders, & Saunders, 2008). Two studies evaluated different sign systems (Amer-Ind versus ASL; Marquardt, Sanchez, & Muñoz, 1999) and different teaching materials (Nozaki et al., 1991). The communicative functions that were investigated in these nine experimental studies, are very limited: to label objects or pictures (n = 7), or to mand for an object or an activity (n = 2). All nine studies concluded that manual signs can be taught successfully to adults with ID.

In another 4 of the 15 experimental studies, the acquisition and/or use of KWS or manual signing was compared with other AAC systems (graphic symbols in Sundberg & Sundberg, 1990 and Wraikat, Sundberg, & Michael, 1991; Picture Exchange Communication System [P.E.C.S.] in Chambers & Rehfeldt, 2003 and Ziomek & Rehfeldt, 2008). These studies stated that manual signing was more successful for teaching adults with ID to label objects compared to graphic symbols, but that P.E.C.S. was more successful for manding compared to manual signing.

The outcome measures of the remaining 2 of the 15 experimental studies, were not manual signing but speech production. Wells (1981) compared the influence of a KWS training and a speech only training on articulation, and concluded that KWS resulted in a greater improvement of articulation. Powell and Clibbens (1994) evaluated the influence of KWS on the intelligibility of spontaneous speech of adults with ID, and found that these adults were better intelligible when they used KWS.

Only 3 of the 18 publications included in this review (Bryen & McGinley, 1991; Faw, Reid, Schepis, Fitzgerald, & Welty, 1981; Schepis et al., 1982), studied the functional use of KWS in adults with ID. Two of these studies were intervention studies (Faw et al., 1981; Schepis et al., 1982), in which KWS was taught to adults with ID in their everyday environment by their support staff. This was partly successful (using incidental training strategies, and when real objects were used as stimuli, but not when pictures were used), although the evaluation of the KWS use in the experiment with the real objects was only evaluated in a labelling task and not in everyday functional communication. The third study on functional KWS use by Bryen & McGinley (1991) was a survey study, and revealed that adults with ID could spontaneously produce a mean of 20 manual signs, and their support staff knew a mean of 23 signs.

2.4. Discussion

The results of the studies that we discussed in this review need to be interpreted with great care. The methodology of most studies does not allow for generalization of the results beyond the participants and the settings of the study. The description of the participants in these studies often lacks information concerning the level of ID (e.g., Schuebel & Lalli, 1992), how this level of ID was determined (e.g., Wraikat et al., 1991), or if additional disabilities were present or not. Most studies concern only (very) small groups of adults with ID, with a mean of 5.72 participants per study. The designs of most studies do not include a control group, and the poorly described methodology of most studies does not enable replication of the studies. Only three studies specifically evaluated the functional use of KWS in the living unit or at the residence of the participants.

This review seems to indicate that very little research concerning the use of KWS in adults with ID has been published during the last 10 years. This might seem surprising. Our results do not suggest that nothing has been published, however, the studies that have been published, were not suitable for inclusion. From the studies included in a review by Schlosser and Sigafoos (2006) for example, all but two (Linton & Singh, 1984; Wells, 1981) were excluded from our study because they only included children or only included participants with ASD. Other more recent publications were excluded for similar reasons (e.g., Chadwick & Jolliffe, 2009, only included support workers of adults with ID as their participants, but not the adults with ID themselves; Gregory, DeLeon, & Richman, 2009, only included children).

Since the 1980 review of Poulton and Algozzine, little has changed in the scientific evidence available concerning the use of KWS in adults with ID. Poulton and Algozzine, like us, concluded that the evidence was scattered and that it was very difficult to draw general conclusions. Poulton and Algozzine (p. 151) stated that “the literature specifically supports the notion that manual signing can facilitate word-object associations. It does not, however, support the contention that retarded persons attain a functional communication system based on manual signing.” This statement corresponds well with our conclusion. Our narrative review shows that manual signs can be taught to adults with ID, using various behavioural techniques, and that they can learn to use the signs for manding and labelling. Very little research is available, however, concerning the functional use of KWS beyond these two communicative functions and beyond the artificial setting of a therapy room. This review, in addition to that of Poulton and Algozzine, clearly demonstrates that there is still a great need for studies that evaluate how adults with ID use KWS in their spontaneous, functional communication.

Chapter 3
The prevalence of key word signing among adults with an intellectual disability in Flanders

The content of this chapter has been described in:

Meuris, K., Maes, B., and Zink, I. (in press). Key word signing usage in residential and day care programs for adults with intellectual disability. Journal of Policy and Practice in Intellectual Disabilities.

Abstract

Background: Key word signing (KWS) is a means of augmentative and alternative communication (AAC) frequently used with adults with intellectual disabilities (ID). Their acquisition of KWS has been described in literature; however, little is known about the everyday KWS use of adults with ID and their support staff.

Specific Aims: This study aimed to give an account of the prevalence of KWS use and the sign knowledge of adults with ID and their support staff in Flemish residential (RP) and day care programs (DP).

Methods: The persons responsible for communication support in all RP and DP for adults with ID in Flanders, the Dutch-speaking part of Belgium, were contacted by phone. They were first asked whether they used KWS, and if so, whether they were willing to fill out a questionnaire about the KWS use of support staff and clients.

Findings: Out of 347 RP and DP available in Flanders, 85% met the inclusion criteria. Half (51.2%) of these programs used KWS. Of these 152 programs, 93 (61.2%) completed our questionnaire. A quarter (26.6%) of their adult clients with ID used KWS. Most of them knew 10 to 50 signs, whereas most support staff knew fewer than 10 signs. The presence of a speech-language pathologist (SLP) as well as sign knowledge and attitude of support staff were significantly related to the sign knowledge of their clients.

Discussion: Although half of the included RP and DP and a quarter of the adults with ID over whom a questionnaire was filled out used KWS, thorough knowledge about KWS was lacking for some service providers. Also, many KWS users and even more support staff knew only a limited number of signs. Motivational problems for staff to use KWS were also quite common. KWS support should therefore be more widespread and more easily accessible.

3.1. Introduction

Key word signing (KWS) is a means of augmentative and alternative communication (AAC) in which key words in a spoken sentence are simultaneously supported by manual signs (Windsor & Fristoe, 1991). It is a multimodal, unaided form of AAC, often referred to more broadly as manual signing (e.g., Schuebel & Lali, 1992). These terms, however, reflect a difference in perspective: manual signing stresses the actual signs whereas KWS emphasizes a multimodal language input with both an oral and a manual component. The main target group of KWS are people with an intellectual disability (ID) who experience communication problems. This study focuses on the KWS use of adults with ID. A survey indicated that over 45% of adults with ID in a UK county had a communication disorder (defined as: problems with expressing basic needs and/or with using communication in social interaction; Blackwell et al., 1989). Rationales for using KWS with this population include the following: (1) signs are a possible alternative when speech cannot be produced because of oral-motor problems (Bryen, Goldman, & Quinlisk-Gill, 1988; Clibbens, 2001); (2) signs are easier to teach than speech because signs can be produced more slowly, parts of a sign can be held still to serve as a visually more static model, and hands can be moulded in the correct hand shape or position (Bryen et al., 1988); (3) using signs does not require any equipment other than the body (Clibbens, 2001; Mirenda, 2003; Sigafoos & Drasgow, 2001); (4) the multimodality of using signs combined with speech may enhance understanding (Sigafoos & Drasgow, 2001); (5) the use of manual signs does not impede speech production and may even enhance it (Schlosser & Wendt, 2008); (6) communication with manual signs is direct, involving normal patterns of eye contact and turn-taking (Clibbens, 2001); (7) signs derive from a natural language and can thus be extended grammatically (Clibbens, 2001). KWS as a method can be applied to signs from any sign language or system. Usually, signs from the local sign language of the deaf are used (for example signs from American Sign Language in Chambers & Rehfeldt, 2003; Elias, Goyos, Saunders, & Saunders, 2008 and Ziomek & Rehfeldt, 2008; and signs from British Sign Language in Chadwick & Jolliffe, 2009 and Rudd, Grove, & Pring, 2007) providing a quasi-limitless vocabulary. Sometimes specific sign systems are used, consisting of a limited set of signs (e.g., Amer-Ind with fewer than 200 signs; Daniloff, Lloyd, & Fristoe, 1983; and *Spreken Met Ondersteuning van Gebaren* ,SMOG [Speaking with support of signs], with about 500 signs; Loncke, Nijs, & Smet, 1998).

Since its introduction in the 1970s (e.g., Bricker, 1972), KWS has been used as a means of AAC with many adults with ID. However, little data exists about these KWS users. Different ways of successfully teaching signs to adults with ID have been described (some more recent examples are Elias et al., 2008; Miller, Collins, & Hemmeter, 2002; and Palmer, Collins, & Schuster, 1999; see Schlosser and Sigafoos, 2006 for a narrative review of single-subject experimental studies), although little attention is given to the prevalence and daily use of KWS. Some surveys were conducted in the 1970s, 1980s and early 1990s, but they give us very little information about the participants. An overview of these surveys can be found in Table 3.1. All surveys were conducted in the United States and concerned mostly people with a moderate to profound ID. Percentages of KWS use in this population vary from 26% (of 454 clients with ID; Goodman, Wilson, & Bornstein, 1978) to 80% (of 46 children with Down syndrome; Sedey, Rosin, & Miller, 1991; in Romski & Sevcik, 1997). Sign knowledge of KWS users ranged from 4 (in students) to 20 (in adults) signs produced spontaneously, however, several clients did not display any functional use of those signs (Bryen et al., 1988; Bryen & McGinley, 1991).

The suitability and success of KWS are determined not only by characteristics of the sign system and the person with ID, but by environmental characteristics as well. Bryen and Joyce (1986) described these characteristics as attitudes of significant others towards KWS, their competence in using KWS, and their actual sign use in both teaching and interacting with the person with ID. People who are unfamiliar with manual signs, untrained in KWS, or unsupportive of it, may be unable to interpret the communicative intent of a KWS user (Chadwick & Jolliffe, 2009). Teaching signs to support staff of adults with ID has been described in literature (Chadwick & Jolliffe, 2009; Faw, Reid, Schepis, Fitzgerald, & Welty, 1981; Fitzgerald et al., 1984; Schepis et al., 1982), and some survey studies concerning the sign knowledge of support staff have been performed by Bryen et al. (1988) and Bryen and McGinley (1991). An overview of this literature can be found in Table 3.2.

Table 3.1. Overview of literature concerning survey data of KWS use.

	National survey of speech, hearing and language services for the retarded (Fristoe & Lloyd, 1978; 1978)	National survey for special education PRs that use manual signing (Goodman, Wilson, & Bornstein, 1978)	Survey for sign use of students with severe to profound ID (Bryen, Goldman, & Quinlisk-Gill, 1988)	Survey for adults with ID living in a residential service (Bryen & McGinley, 1991)	Survey among children with Down syndrome (Sedey, Rosin, & Miller, 1991; in Romski & Sevcik, 1997)
Location	United States	United States	one state in the United States, NS	United States	Unites States
Number of contacted service PRs / subjects	NS	200 PRs	27 SLP in 21 PRs	NS	NS
Number of respondents	689 PRs	127 PRs with approx. 4,000 KWS users	17 SLP in 12 PRs with 454 clients	10 residential PRs with 17 KWS users	46 children with Down syndrome
Response rate	NS	64%	63% (SLP), 57% (PRs)	NS	NS
Percentage of respondents using KWS	12% of the PRs indicated using some form of nonverbal communication, most frequently manual signs	NS	26% of the clients	NS	80% of the children
Age of KWS users	NS	55% were six years old or younger	"students", NS	"adults", NS	"children", NS
Level of ID of KWS users	moderate to severe ID	most PRs had clients with moderate (72%) and severe (79%) ID	98% had severe to profound ID, often with additional disabilities	NS	NS
Sign knowledge of KWS users	NS	NS	average of nine signs imitated and four signs produced spontaneously	average of 20 signs produced spontaneously	NS
Sign use of KWS users	NS	NS	no functional use indicated for several clients	NS	NS

Note. KWS = key word signing, PR = program, NS = not specified, ID = intellectual disability, SLP = speech-language pathologist.

Table 3.2. Overview of literature concerning sign knowledge and use of support staff.

	Faw, Reid, Schepis, Fitzgerald, and Welty. (1981)	Fitzgerald et al. (1984)	Schepis et al. (1982)	Chadwick and Jolliffe (2009)	Bryen, Goldman, and Quinlisk-Gill (1988)	Bryen and McGinley, 1991
Number of support staff	6 support workers	6 support workers, 7 paramedics	15 support workers	30 support workers	NS	11 support workers
Number of signs taught	34	34 to support workers, 21 to paramedics	17	20	NS	NS
Measure of sign knowledge	NS	mean sign knowledge of 80 to 100% of the signs, measured at follow-up intervals until 11 weeks post training	NS	mean sign knowledge of 95%, measured at follow-up intervals 6 to 12 months post training	mean number of signs known by therapists 179, by teachers 73, by caregivers 13	mean number of signs known 23
Measure of sign use	effective use of the signs during 11 to 15% of the observed time	NS	73% of participants reported to use the signs ”somewhat frequently”	50% of participants reported to use the signs ”rarely”	NS	average use of 2 signs per 30 minutes observed time
Measure of attitude towards KWS	NS	NS	100% of participants reported that ”signing was at least somewhat useful”	NS	NS	NS

Note. NS = not specified.

Overall, these papers show us that support staff could be taught a limited set of signs, but that this did not guarantee that those signs were used in functional communication. Bryen et al. (1988) also found that those caregivers who had the most contact with the persons with ID and thus the greatest impact on their language learning, had the least competence with signs. Staff of adults with ID knew only slightly more signs than their clients, and no correlations between sign knowledge of support staff and that of their clients were found. Support workers also often failed to interact with their clients at all (Bryen & McGinley, 1991). The authors stated that three basic conditions needed to be improved in order for KWS to be a functional form of AAC: (1) the staff-client interaction needed to increase; (2) the sign knowledge of the staff needed to improve; and (3) the staff needed to use KWS consistently in all natural interactions with their clients. Thus, besides a lack of staff-client interaction, both a lack of sign knowledge and of sign use were apparent.

3.1.1. Research questions

The literature described gives some information concerning the sign knowledge and use of adults with ID and their support staff, but does not give an indication of the prevalence of signing across service providers, or the extent of sign knowledge of staff in relation to that of the KWS users they directly support. The aim of this study was to map the use of KWS in all residential and day care programs for adults with ID in Flanders, Belgium. We did not only focus on the KWS users themselves, but also on a key aspect of their communicative environment, i.e., their support staff. In this first exploratory study performed in Flanders, most attention is given to the sign knowledge of both KWS users and support staff. However, it is important to bear in mind that this is only one aspect influencing the success of KWS, besides the two other aspects of sign use and communicative interaction. Because of the nature of this present survey study, the latter two aspects were not emphasized.

The research questions addressed in this study are:

1. How many residential and day care programs for adults with ID in Flanders use KWS with one or more clients?
2. How many clients in these programs use KWS?
3. How many signs do the clients using KWS comprehend and produce?
4. How many signs does the support staff of these clients comprehend and produce?
5. What is the relationship between different characteristics of support staff, clients, and service providers and the sign knowledge of both the support staff and their clients?

3.2. Methods

In order to address these research questions, both a telephone and a written questionnaire were conducted with all providers of residential and day care programs for adults with ID in Flanders, the northern Dutch-speaking part of Belgium with over 6 million inhabitants.

3.2.1. Participants

All Flemish service providers (acknowledged by the Flemish Agency for Persons with a Disability, FAPD) providing residential and/or day care programs for adults with ID were contacted in this study. Residential programs (RP) provide housing in group homes, where small groups of adults live together with permanent or temporary support of support workers and/or paramedics. Different group homes are usually administratively joined into one RP. Day care programs (DP) can offer different types of support, from intensively assisted workshops, to supported work in various workplaces across the region. DP are attended by clients who live at home (alone or with support from family). At the time of the study, a total of 347 RP and DP for adults existed in Flanders (222 RP and 125 DP). These programs were administered by 206 service providers (102 providers offer a RP and a DP, 79 providers offer only a RP and 25 only a DP). As each program was contacted separately (even if a service provider offered both a RP and a DP), the results will be discussed per program and not per service provider. As the only inclusion criterion was to provide services for adults (> 18 years of age) with ID, the nature of the clients in these programs varied from clients with a mild ID without any additional disorders, to clients with severe multiple disabilities. The inclusion criteria were kept this liberal in order to obtain a very broad view on the current use of KWS in adults with ID in Flanders. Exclusion criteria were supporting clients with physical disabilities without ID, clients with acquired brain damage or clients who are profoundly deaf and/or profoundly blind.

3.2.2. Key Word Signing system

In Flanders, the sign system with a KWS approach most commonly used is called *Spreken Met Ondersteuning van Gebaren* (Speaking with support of signs, SMOG; Loncke et al., 1998). It consists of about 500 signs, mainly adapted from Flemish Sign Language.

3.2.3. Design

A cross-sectional mixed mode survey design (Dillman, Smyth, & Christian, 2009) was carried out between May 2009 and February 2011. This survey combined the use of telephone, mail (both postal and electronic), and web procedures to collect data. The study was conducted in two phases. The first phase consisted of a telephone survey and in the second phase a questionnaire was sent out. The procedure and results of the study are described by phase. The ethical board of Leuven University Hospital approved the study protocol. Data analyses were performed using SPSS software (version 16.0). Besides descriptive statistics, only nonparametric tests were used because no continuous variables in this study have a normal distribution (verified by Kolmogorov-Smirnov tests). For categorical predictors, Mann-Whitney (U) and Kruskal-Wallis (H) tests were used to assess group differences with a continuous outcome variable. Chi-square tests (χ^2) were used for categorical outcome variables. If expected cell counts in a 2x2-table were fewer than five, Fisher's exact test (FET) was used. For continuous predictors with a continuous or binary categorical outcome variable, Spearman's correlation (r_s) was used. All variables and their nature are described in the next part of the methods section for each phase. $P < .05$ is considered statistically significant.

3.3. Phase 1: Telephone Survey

3.3.1. Procedure

To obtain an indication of the prevalence of KWS use in RP and DP for adults with ID in Flanders, a telephone survey was conducted. All 347 Flemish RP and

DP were contacted by phone by four researchers (one SLP and three master's-level SLP students). The phone scenario was written out in full, practiced in role play during half a day, and always present next to the telephone on a reminder card to ensure a standardized administration. First, we ensured our inclusion criteria were met, and if this was not the case, the call was concluded and the program was excluded from the study. We then asked to speak with the person responsible for language and communication support of the clients, and asked if KWS was used with one or more clients. ”Using KWS” was specified as making use of KWS for support in language comprehension and/or language production. If this question was answered negatively, we asked for the reason(s) why KWS was not used. This was recorded by writing down the statement of the contact person literally. The different answers were analysed via content analysis with emergent category coding (Stemler, 2001). If it was answered positively, we asked if the person(s) responsible for KWS in the program would like to fill out a questionnaire regarding KWS. Data concerning the number of clients and support staff in each program were gathered through the FAPD. Variables analysed in this phase of the study include use of KWS (binary categorical variable) and number of clients supported by the program (continuous variable).

3.3.2. Phase 1: Results

The results of phase 1 are displayed in Table 3.3. Most of the contacted programs (85.6%) met the inclusion criteria. The requested information was provided mostly by psychologists (33.3%), coordinating support workers (25.9%), SLPs (25.2%), and management (11.6%). The reason for the large variation in number of clients per program is administrative: some residential programs consisted of only one group home, whereas others grouped several group homes. KWS was used with one or more clients in 51.2% of the programs, supporting 74.3% of the clients. This means that KWS may be available to 74.3% of the adults with ID making use of the included programs in Flanders. A significant moderate correlation between number of clients of a program and the use of KWS was found ($r_s = .40$, $p < .001$), reflecting that KWS was used more frequently in larger programs.

Table 3.3. Results of phase one.

Contacted programs	347	
Included programs	297	85.6% of contacted programs
Total number of clients in included programs	13,135	73.5% in RP, 26.5% in DP
Average number of clients per program	44.2	Min 1, max 400, *SD* = 52.9
Total number of FTE support staff in included programs	5,785.5	90.0% in RP, 10.0% in DP
Programs using KWS with one or more clients	152	51.2% of included programs
Total number of clients in KWS-using programs	9,756	74.3% of total number of clients in included programs
Total number of FTE support staff in KWS-using programs	4,586.0	79.3% of total number of FTE support staff in included programs
Programs willing to fill out the questionnaire	142	93.4% of KWS-using programs

Note. RP = residential program, DP = day care program, min = minimum, max = maximum, FTE = full-time equivalent, KWS = key word signing

The majority of the programs that used KWS (93.4%) agreed to fill out the questionnaire. Most of the programs where KWS was not used, gave reasons for this (114 of 145 or 78.6%). Via content analysis with emergent category coding (Stemler, 2001), four researchers categorized these 114 statements into six categories (two researchers defined these categories with mutual agreement and categorized the 114 statements, two other researchers repeated this task, inter-rater agreement of 100%): clients that are verbally strong enough or that do not need AAC support (67 of 114 or 58.8%), difficulties implementing a KWS system (18 of 114 or 15.8%), no knowledge of KWS (15 of 114 or 13.2%), preference for aided AAC systems (such as pictograms) (7 of 114 or 6.1%), clients with additional psychological problems (4 of 114 or 3.5%), and clients with too severe physical disabilities (3 of 114 or 2.6%). Nine programs reported to have used KWS before, but they decided to discontinue using it because of motivational difficulties of the staff.

Table 3.4. Overview of data drawn from KWS questionnaire.

Type of variable	Variable description	Results (N = 93 respondents, unless otherwise stated)
	Part 1: contact and organizational information	
CaV	1. Profession of respondent	
	a) psychologist	35.5%
	b) SLP	36.6%
	c) support worker	20.4%
	d) other	7.5%
CoV	2. Total number of clients with (congenital) ID, without profound deafness / blindness	7,197 (M = 77.4, min 6, max 400, SD = 74.0)
CoV	3. Number of clients per degree of ID	
	- mild	8.4%
	- moderate	41.7%
	- severe	34.4%
	- profound	15.5%
CaV	4. Is an SLP available? (yes / no)	yes: 44.1%
	Part 2: use of KWS by adults with ID	
CoV	5. Number of clients using KWS (for aid in receptive and/or productive communication)	1,902 (26.6% of total; M = 20.9, min 2, max 48, SD = 11.0; n = 91)
CaV	6. Degree of ID of each KWS user	n = 91
	a) mild	7.2%
	b) moderate	34.8%
	c) severe	53.5%
	d) profound	4.5%
CaV	7. Estimated number of signs comprehended / produced by each KWS user	see Figure 3.2; n = 91
	a) fewer than 10 signs	
	b) 10 to 50 signs	
	c) 50 to 200 signs	
	d) more than 200 signs	
	Part 3: use of KWS by support staff	
CaV	8. Is KWS taught to support staff? (yes / no)	yes: 90.3%
CaV	9. Profession of KWS teacher	*(> 1 answer possible, total > 100%)*
	a) psychologist	10.8%
	b) SLP	48.4%
	c) support worker	47.3%
	d) other	9.7%
CaV	10. Estimated number of signs comprehended / produced by majority (> 50%) of support staff	see Figure 3.1; n = 82
	a) fewer than 10 signs	
	b) 10 to 50 signs	
	c) 50 to 200 signs	
	d) more than 200 signs	
CaV	11. Estimated attitude towards KWS of majority (> 50%) of support staff	*(> 1 answer possible, total > 100%)*
	a) positive	68.8%
	b) negative	0.0%
	c) indifferent	22.6%
	d) other	24.7%

Note. KWS = key word signing; CaV = Categorical variable, multiple-choice question; CoV = Continuous variable, open question; SLP = speech-language pathologist, min = minimum, max = maximum; ID = intellectual disability.

3.4. Phase 2: Questionnaire

3.4.1. Procedure

Because recent literature on the everyday KWS use in adults with ID is not available, a questionnaire was developed. The first version of the questionnaire was composed based on our research questions and the clinical experience with KWS of the authors (two SLPs and a psychologist). This version was discussed in a focus group consisting of six experienced SLPs working in an RP for adults with ID. The questionnaire was revised and then pretested by two other SLPs working in the field. Revisions made throughout the process were: shortening of the questionnaire to make it less time-consuming to fill out, changing open questions to multiple-choice questions for ease of use and easier processing of the data, adding categories to multiple-choice questions based on the situation in the field, narrowing down the categories of sign comprehension and production to make estimations of sign knowledge easier, explaining what is meant by the categories in estimated attitude of staff, and adapting the terminology to that used in the field (for example ”signs actively used” besides ”sign production”). The finalized questionnaire[2] consisted of three parts. A summarized version and the variables drawn from the questionnaire can be found in Table 3.4. In the first part contact and organizational information was collected. The second part consisted of questions about the use of KWS by adults with ID. In the third and last part the use of and attitude towards KWS by support staff, as estimated by the respondent, was questioned. The questionnaire was available both on paper and electronically. Respondents were free to choose either the paper or electronic version, taking into account their situation (access to a computer or not). Respondents opting for a paper questionnaire received it by post (with a prepaid return envelope included) or as a PDF document by email for them to print out themselves (as was opted). The web based electronic version of the questionnaire was created using Limesurvey™ software (Limesurvey team, 2010), and was delivered by email with a hyperlink and a unique access code. The questionnaire was always accompanied by an informed consent and a letter in which we asked the person

[2] The entire questionnaire can be obtained via email from the authors.

responsible for teaching and maintaining KWS in the program to fill out the questionnaire. This person was required to have attended an official KWS training and to have at least one year of experience with KWS. Respondents were encouraged to consult their colleagues in order to complete the questionnaire as accurately as possible. They were asked to return the completed survey within one month. If no response was received, reminders were sent out (first by email, then by phone).

3.4.2. Phase 2: Results

Of the 142 questionnaires that were sent out, 93 were returned. This resulted in an overall response rate of 65.5%. The results of the questionnaire can be found in Table 3.4.

3.4.2.1. Part 1: contact and organizational information

As can be seen in Table 3.4, the questionnaire was most frequently filled out by an SLP (36.6%) or a psychologist (35.5%). The 93 participating programs served a total of 7,197 clients, with most of them having a moderate (41.7%) to severe (34.4%) ID. The programs employed 3,169.1 full-time equivalent (FTE) support workers (*M* = 39.2, data from the FAPD), and in 44.1% of the programs an SLP was present.

3.4.2.2. Part 2: use of KWS by adults with ID

Of the 93 programs that completed the questionnaire, 91 provided information about the number of clients using KWS. A total of 1,902 clients (26.6% of all 7147 clients) used KWS in these 91 programs. The mean proportion of KWS users was .40 (minimum = .02, maximum = 1, *SD* = 0.31). For 1,727 of these KWS users, information was provided regarding their degree of ID, estimated sign comprehension and estimated sign production. Results are shown in Figure 3.1 (for all clients and per degree of ID). Most clients had a moderate (34.8%) to severe (53.5%) ID and were estimated to comprehend (45.0%) and produce (41.6%) 10 to 50 signs.

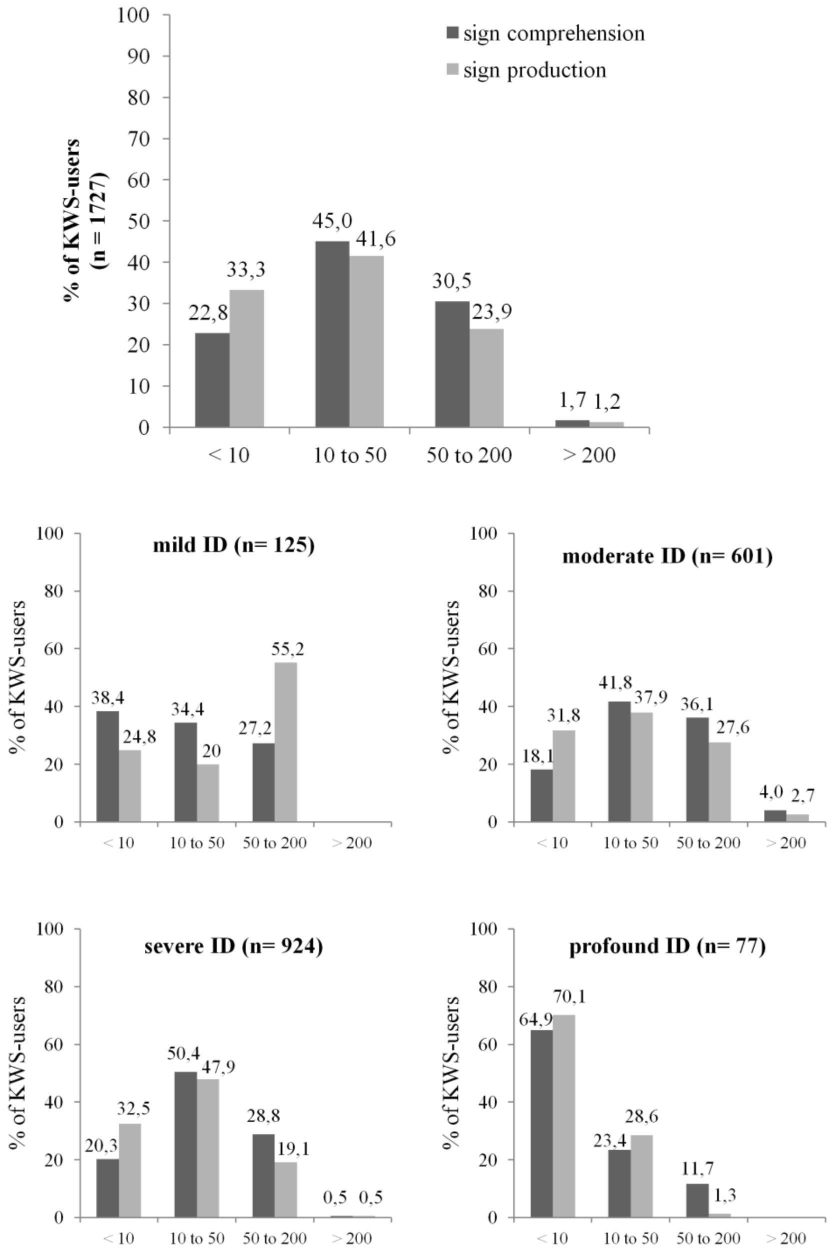

Figure 3.1. Estimated sign comprehension and production for key word signing users in 93 questioned programs: for the total of 1,727 clients; and per degree of intellectual disability (mild, moderate, severe, and profound).

3.4.2.3. Part 3: use of KWS by support staff

KWS was taught to the support staff in most, but not all, of the programs (90.3%). This was done most frequently by an SLP (48.4%) or support worker (47.3%). Information about the sign knowledge of the support staff was given by 82 respondents, concerning 2,794.3 FTE support staff, and is displayed in Figure 3.2.

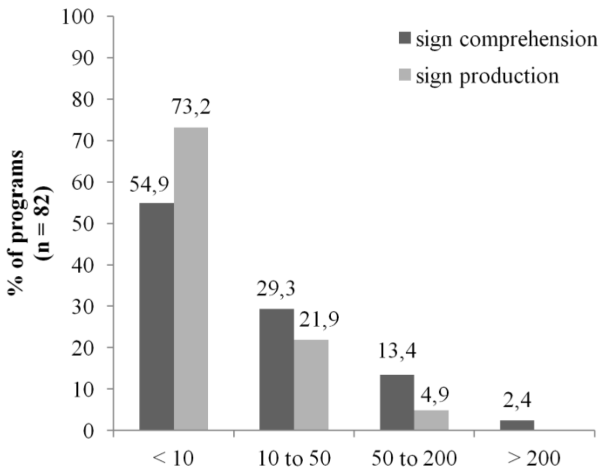

Figure 3.2. Estimated sign comprehension and production of majority of support staff in 82 of the questioned programs, concerning 2,794.3 full-time equivalent support staff.

In most of the programs, the majority of the support staff was estimated to comprehend (54.9%) and produce (73.2%) fewer than 10 signs. Besides their sign knowledge, the estimated attitude of the majority of support staff towards KWS was also questioned. This estimated staff attitude was indicated as *positive* by most of the respondents (68.8%), as *indifferent* by 22.6% and as *other* by 24.7% (total exceeds 100% because some respondents chose to indicate more than one attitude description). Respondents who indicated *other* all stated that support staff was interested in KWS, but that it was very difficult to motivate them to use it on an everyday basis and to implement KWS in the program.

Table 3.5. Overview of data analysis.

Ref. nr. Table 3.4	Variable of interest	Results statistical tests
5.	***Number of clients using KWS→ Proportion of KWS users***	
2.	proportion of KWS users x total number of clients	r_s = .39, p < .001
8.	proportion of KWS users x KWS taught to staff	U = 644, z = 2.6, p = .009, r = .27
7.	***Estimated sign comprehension and production of KWS users***	
4.	comprehension KWS users x presence SLP	χ^2 (3) = 15.5, p = .016
	production KWS users x presence SLP	χ^2 (3) = 36.9, p < .001
5.	comprehension KWS users x number of clients using KWS	H(3) = 25.1, p < .001
	production KWS users x number of clients using KWS	H(3) = 85.1, p < .001
6.	comprehension KWS users x degree of ID of KWS users	FET = 123.8, p < .001
	production KWS users x degree of ID of KWS users	FET = 148.4, p < .001
7.	comprehension KWS users x production KWS users	FET = 1100.8, p < .001
8.	comprehension KWS users x KWS taught to staff	FET = 24.6, p < .001
	production KWS users x KWS taught to staff	FET = 20.6, p < .001
9.	comprehension KWS users x profession KWS teacher	FET = 96.4, p < .001
	production KWS users x profession KWS teacher	FET = 271.8, p < .001
11.	comprehension KWS users x attitude staff	FET = 111.3, p < .001
	production KWS users x attitude staff	FET = 384.3, p < .001
10.	***Estimated sign comprehension and production of support staff***	
6.	comprehension staff x degree of ID of clients	FET = 297.1, p < .001
	production staff x degree of ID of clients	FET = 69.9, p < .001
7.	comprehension KWS users x comprehension staff	FET = 240.6, p < .001
	comprehension KWS users x production staff	FET = 155.6, p < .001
	production KWS users x comprehension staff	FET = 322.4, p < .001
	production KWS users x production staff	FET = 110.4, p < .001
9.	comprehension staff x profession KWS teacher	FET = 12.2, ns
	production staff x profession KWS teacher	FET = 47.7, p = .048
10.	comprehension staff x production staff	FET = 70.6, p < .001
11.	comprehension staff x attitude staff	FET = 37.0, p = .024
	production staff x attitude staff	FET = 14.3, ns

Note. Ref. nr. Table 3.4 = number of variable as can be found in Table 3.4; KWS = key word signing; SLP = speech-language pathologist; ID = intellectual disability; FET = Fisher's exact test; ns = nonsignificant.
Bonferroni correction applied.

3.4.2.4. Relationship between different variables

In order to gain more insight in these results, we looked at the relationships between possibly influencing variables and our three main outcome variables. An overview of the statistical test results can be found in Table 3.5. To further interpret the results of these analyses, post-hoc tests were administered where appropriate (Jonckheere's test for post-hoc analysis of Kruskal-Wallis tests). Also, to interpret the results of chi-square tests or FET, we looked at the standardized residuals of the cross-tabulations and describe the contributing contrasts between different categories where appropriate.

Our first outcome variable of particular interest, as is clear from our research questions, is **how many clients use KWS** or, more relevant to the calculations that we made, the proportion of KWS users. The proportion of KWS users related significantly and moderately positively with the total number of clients in a program, so in larger programs, KWS was used with a larger proportion of clients. Also, in programs where a larger proportion of clients used KWS, it was taught to support staff significantly more frequently.

Our second outcome variable is the estimated **sign knowledge of the adult KWS users with ID**. Sign comprehension and production of KWS users related significantly to each other, as would be expected. The clients' sign knowledge was also related to their degree of ID. The more severe their degree of ID, the fewer signs the clients were estimated to comprehend and produce. The estimated sign comprehension and production were further significantly related to the total number of clients using KWS. A significant trend was revealed by Jonckheere's test (J = 521554.0, z = 2.7, p = .004, r = .07): when more KWS users were present in the program, the individual client was estimated to produce more signs. Sign knowledge of KWS users was also significantly related to characteristics of their support staff. When an SLP was present, both the estimated sign comprehension and production were more likely to be higher. This was also the case when an SLP taught them KWS, and the estimated sign comprehension and production were lower when a support worker did this. When KWS was taught to support staff, clients overall were estimated to comprehend and produce more signs. The estimated attitude of the support staff proved to relate significantly to the sign knowledge of their clients as well. The estimated sign comprehension and production of clients was generally lower when the support staff was perceived to have motivational issues or when they were indifferent to KWS, and higher when the support staff was estimated to have a positive attitude.

The final outcome variable of interest is the estimated **sign knowledge of support staff**. As expected, the estimated sign comprehension and production of staff were significantly related to each other. Sign knowledge of support staff was also significantly related to characteristics of their clients. Support staff was estimated to comprehend and produce significantly fewer signs when their clients had a more severe ID. The sign knowledge of support staff related significantly to that of their clients as well. When the support staff was estimated to comprehend and produce more signs, so did their clients. Besides characteristics of their clients, the profession of the person who teaches KWS to staff seemed to be an influencing factor with regard to their sign production (but not sign comprehension). When an SLP taught KWS, support staff was significantly more likely estimated to produce more than 200 signs; when a support worker taught KWS, support staff was more likely estimated to produce 10 to 50 signs. Finally, staff attitude proved to be related significantly to their sign comprehension (but not to sign production). When the majority of the support staff was estimated to comprehend fewer than 10 signs, their estimated attitude was more likely to be *indifferent*. Support staff estimated to comprehend 10 to 50 signs, more likely had an estimated *other* attitude (motivational problems). An estimated *positive* attitude was more likely to be found when the majority of the support staff was estimated to comprehend more than 200 signs. To conclude, the estimated attitude of support staff was studied in relation to the profession of the KWS teacher. When a support worker taught KWS, the estimated attitude of the majority of support staff was significantly more likely to be *positive* as opposed to *indifferent*; when an SLP taught KWS, the estimated attitude of the majority of support staff was more likely to be *indifferent* as opposed to *positive* (FET = 39.1, p = .030).

3.5. Discussion

Even though KWS is described frequently as a means of AAC for adults with ID, to date we do not know to what extent it is being used. To our knowledge, the extent of everyday use of KWS has not been explored since the 1980s. This study looked at the prevalence and daily use of KWS in adults with ID living in Flanders, Belgium, with an emphasis on their sign knowledge. Both the KWS knowledge of individuals with ID and that of their communication partners were addressed.

3.5.1. Phase 1

KWS was used in more than half of the Flemish residential and day care programs for adults with ID. Little comparable published numerical data concerning the use of KWS in this population were found. The 12% of respondents using some form of nonverbal communication, ”most frequently manual signs”, in the United States in 1975 (Fristoe & Lloyd, 1977) are considerably less than the 51.2% found in this study. These two surveys are difficult to compare because aided forms of AAC were included in the mentioned survey as well, but AAC awareness in general seems to have increased substantially since the 1970s. The current study showed that 74.3% of all adults with ID making use of the questioned programs could have access to KWS. This seems like quite a large group of individuals. In reality this figure may have been lower, taking into account practical issues (limited availability of staff and time to teach persons KWS) and characteristics of these clients (they very likely do not all need KWS support, or are not all capable of using KWS). Still, some people who could benefit from using KWS might not get access to it because of a lack of KWS knowledge, motivation, and implementation. This difficulty has been described in previous literature as well (Chadwick & Jolliffe, 2009; Faw et al., 1981), and points out the importance of a solid KWS introduction and training for staff working with people with ID. As many of the respondents who did not use KWS communicated a lack of KWS knowledge, there certainly proves to be room for improvement. Still, it might not be easy to access the necessary resources. Especially in smaller providers this risk exists, whereas in larger providers, KWS was used significantly more frequently. These latter providers possibly can devote more time and money to the introduction and implementation of KWS. Lack of time and money is a frequent complaint in this sector (e.g., Parsons, Daniels, Porter & Robertson, 2007), and does have important implications on availability of resources for communication intervention. We suggest that if AAC in general, and KWS in particular, would be addressed in all education programs for support workers, psychologists, and paramedics, this lack of knowledge could be minimized without too high of an investment. Second, the availability of a nationwide KWS support centre, partly financed by public funds, would be very welcome in Belgium (and possibly in several other countries). The authors are aware of the existence of KWS support centres for example in Ireland (for Lámh, the Irish KWS system; Lámh, 2013) and the United Kingdom (for Makaton, an AAC system including KWS; The Makaton Charity, 2013), which offer broad support from informing to training, both for parents and professionals.

3.5.2. Phase 2

A response rate of 65.5% was obtained on the questionnaires in this study, which is comparable to the response rates of 64% and 63% described by Goodman et al. (1978) and Bryen et al. (1988). When using questionnaires, we must keep in mind that self-report data can potentially be subject to recall and social desirability bias. Also, respondents were asked to estimate sign knowledge of staff and clients, and attitude of staff. Data are not based on extensive observations and this should be kept in mind when examining the data.

The main focus of this study was the sign use and knowledge of adults with ID. More than one quarter of all clients making use of the questioned programs, used KWS. This is comparable to the 26% of KWS users in the survey of Bryen et al. (1988). Many KWS users described in our study, knew fewer than 10 signs. Most clients comprehended and produced fewer than 50 signs. This seems to correspond to what Bryen and McGinley (1991) reported for adults with ID. Most clients using KWS had a moderate to severe ID (comparable to Bryen et al., 1988; Fristoe & Lloyd, 1978; and Goodman et al., 1978) and the number of signs they used is related significantly to their degree of ID. People with moderate to severe ID often have a lack of verbal abilities, but adequate intellectual abilities to acquire a symbolic communication system (Harris & Reichle, 2004). When more KWS users were present, the individual KWS user knew more signs. This might be caused by the presence of more interlocutors, providing more chances to learn and use KWS.

Besides the sign knowledge of adults with ID, this study looked at sign use and knowledge of support staff. Most support staff was estimated to comprehend and produce fewer than 10 signs. Sign knowledge of support staff was mainly associated with the level of ID of their clients and their sign comprehension and production (contrary to what Bryen et al. [1988] and Bryen and McGinley [1991] found). Of course, a significant relationship does not indicate a causal relation, so whether the sign knowledge of the support workers was influenced by that of their clients, or vice versa, cannot be determined. Still, in our study, support staff generally was estimated to know fewer signs than their clients, contrary to staff in the studies of Bryen et al. (1988) and Bryen and McGinley (1991), who knew slightly more. When the sign knowledge of support workers is lower than that of their clients, this could cause a problem. One can only teach what one knows. Adults with ID can keep evolving and learning (e.g., Elias et al., 2008; Miller et al., 2002; Palmer et al., 1999), but might very often be restricted by the reduced learning possibilities offered by their environment. As Bryen and Joyce (1986) described, significant others without a minimal level of both sign competence and sign use cannot possibly function as a model and will make a KWS intervention unlikely to succeed. It is unclear if this limited sign knowledge of staff is a problem of sign acquisition, maintenance, or application. In almost 10% of the programs, KWS was not taught to the support workers. This is very concerning, because teaching KWS to communication partners is an essential part of implementation of KWS in any environment. This is confirmed by its relationship with the sign comprehension and production of clients. Knowledge of the communication means used by a person who uses AAC seems essential for the AAC intervention to be successful. Although clients and staff may interact on a daily basis, this does not automatically mean that staff is interpreting signals from their clients correctly. McConkey, Morris, and Purcell (1999), Bradshaw (2001) and Healy and Walsh (2007) found that staff tend to underestimate their own use of verbal communication and overestimate their use of nonverbal communication, and suggested a good training might help in attuning staff communication to that of their clients. In most of the questioned providers however, KWS was taught to support staff, more frequently when a larger proportion of KWS users were present. For these people acquisition did not seem the problem. Clinical reports reveal that both maintenance and actual application of sign knowledge can be problematic. In Schepis et al. (1982), support staff reported to use the signs they had learned ”somewhat frequently”, and in Chadwick and Jolliffe (2009), although they had an accurate sign knowledge, 50% of the staff reported to have used the signs rarely. This points more in the direction of an application problem, and might be related to the motivational issues frequently stated by our respondents. Maintenance and application of KWS should be further investigated, and we believe the attitude of staff should not be overlooked with regard to these aspects of KWS use (see further).

Other characteristics of the support staff, besides their sign knowledge, were examined as well in this study and seemed to relate to the sign knowledge of their clients. Again, in this study, no causal relationships could be determined, so whether the sign use of clients influences the characteristics of their staff or vice versa, cannot be stated. A first relating factor is the presence of an SLP. An SLP was present and taught KWS to clients and staff in almost half of the questioned programs (Goodman et al. [1978] also reported an SLP to be responsible for KWS in ”most of the programs”). Both support staff and clients knew significantly more signs when an SLP taught KWS as opposed to when KWS was taught by a support worker. It seems as if, probably because of their schooling, SLPs are better suited to teach KWS to clients and support workers than support workers themselves. However, the position of an SLP can be difficult in this matter, because (s)he is often not present in the daily environment of the client but works outside of the group homes or day care centres in a therapy room. This lack of attunement with the daily life could be reflected by the attitude of support staff. Their estimated attitude towards KWS was more frequently *indifferent* when an SLP taught KWS, and more frequently *positive* when a support worker did. The clinically frequently cited lack of visibility of the SLP, and overemphasis on treating patients at the expense of supporting support staff in their communication, could possibly explain this attitude change. Therefore, a *train-the-trainer* vision seems appropriate, in which the SLP trains support workers so that they are able to pass on their knowledge to their colleagues. Of course, the attitude of support staff in this study was only questioned in a very limited and exploratory way by asking the respondents to estimate the attitude of the majority of the staff. More comprehensive and nuanced information could be gathered by using more detailed attitude questionnaires and by questioning the staff in person. Still, it seems worthwhile to try to influence the attitude of support staff in a positive way, because staff attitude is related to the sign comprehension and production of their clients. Furthermore, the attitude of support staff was more likely to be *positive* when they comprehended more than 200 signs. This might suggest that one needs to know a KWS system quite well to be able to use it in a useful and motivating manner. Apparently, comprehending more than 200 signs gives a better basis to be able to use KWS fluently on an everyday basis. This strengthens the presumption that, if a program chooses to introduce KWS and wants to invest in it, they best go “all the way” with it and give their staff proper training. This was also suggested by Bryen and Joyce (1986), who pleaded for extensive KWS training for both staff and caregivers. However, not every program can or will employ an SLP and/or invest in KWS training. A good KWS training should be available for all providers, regardless of their number of clients, time, or money. Also, focus should not only be on acquisition of KWS, but on maintenance and correct application as well, with special attention for motivating the support staff to use KWS. A centrally organised support network for programs and individuals using KWS could provide support and resources. SLPs could serve as communication coaches to educate and train support workers. This is also, more broadly than just for KWS, suggested in literature. Bradshaw (2001); Dobson, Upadhyaya, and Stanley (2002); Healy and Walsh (2007); Purcell, McConkey, and Morris (2000); and Schuengel, Kef, Damen, and Worm (2010) proposed that the right kind of communication training may improve caregiver’s attunement to their clients. A work-based training program which includes video-based interaction guidance is most frequently proposed. Schuengel et al. (2010) suggested that communication training never ends, and that training and counselling may be required on a regular basis. In most studies (Bradshaw, 2001; Dobson et al., 2002; McConkey et al., 1999; Purcell et al., 2000) an SLP was involved in observing and training of support workers. By providing KWS support that is more readily available, KWS knowledge can be more broadly spread, and clients for whom KWS would be a suitable form of AAC can be more easily recognized and better supported.

3.6. Conclusion

This paper is set out to be a first step in acquiring knowledge on the everyday situation of adult KWS users. This study gave an indication of the number of adults with ID, making use of RP and DP in Flanders, that use KWS. We also provided an estimation of how many signs the KWS users and their support staff comprehend and produce. It would be very interesting to compare this situation to other countries. Quite a lot of individuals with ID seem to use KWS in Flanders, but many of them only use a limited number of signs. Sign knowledge of clients relates to sign knowledge of their support staff, and the latter is usually very limited. These findings imply the need for better training for support workers, and more easily accessible KWS support. SLPs might play an important role in training and supporting support workers, and a *train-the-trainer* approach may be most beneficial. This study has pointed out, however, that SLPs seem to reach the best results in teaching the signs to the adults with ID, because the latter know significantly more signs when taught by an SLP. This study did have some limitations. First, the method used implies some disadvantages. The programs were only contacted once and only one informant was contacted with regard to the telephone survey. A more rigorous methodology would involve contacting multiple informants at multiple times, but this was not done due to a lack of staff and time. Also, we relied on the information provided to us by informants with their own convictions, ideas, and experiences, which undoubtedly influenced the information they provided. On the other hand, gathering the same wealth of information through other methods such as direct observation, would require much more time and resources. The sign knowledge of both the adults with ID and their support staff in this study was not measured directly but was estimated by the person responsible for teaching and maintaining KWS in the program. Of course, a more accurate method would be to directly observe the KWS use of the adults with ID and staff, which, due to the large number of people involved, was not feasible in this study. However, in a subsequent study, a smaller number of both adults with ID and their support staff, will be observed and their sign knowledge will be measured more directly using spontaneous conversation analysis. Finally, the sign knowledge of adults with ID is only one very small part of the way they use KWS. The current study has not examined which signs and sign combinations KWS users spontaneously use, nor the functionality of their communication. The question remains whether KWS is the best option for the individuals using it, and whether it is an effective means of AAC for them. Does KWS really support their communication? Also, different characteristics of the KWS users, such as level of language development, communication skills, and motor and imitation skills should be studied. Therefore, more observational and qualitative studies are needed to find out what the strong points and setbacks of everyday KWS use by adults with ID are. Within the framework of this research project, a new questionnaire concerning some of these topics has already been sent out and completed for more than 100 KWS users with ID. In a next phase, as described above, a number of KWS users and their support staff will be observed in their natural everyday setting. Via an intervention study giving support workers proper KWS training, we will investigate the effect of this training on the sign use of adults with ID.

This will eventually result in more knowledge about and openness concerning KWS so that people who could benefit from using it, receive proper and high-quality access to KWS.

Chapter 4
The relation between sign characteristics and the functional sign vocabulary of adult key word signing users with intellectual disability

The content of this chapter has been described in:

Meuris, K., Maes, B., De Meyer, A., and Zink, I. (2014). Manual signing in adults with intellectual disability: Influence of sign characteristics on functional sign vocabulary. Journal of Speech, Language, and Hearing Research, 57, 990-1010.

Abstract

Purpose: The purpose of this study was to investigate the influence of sign characteristics in a key word signing (KWS) system on the functional use of those signs by adults with intellectual disability (ID).

Method: All 507 signs from a Flemish KWS system were characterized in terms of phonological, iconic and referential characteristics. Phonological and referential characteristics were assigned to the signs by speech-language pathologists. The iconicity (i.e., transparency, guessing the meaning of the sign; and translucency, rating on a 6-point scale) of the signs were tested in 467 students. Sign functionality was studied in 119 adults with ID (mean mental age of 50.54 months) by means of a questionnaire, filled out by a support worker.

Results: A generalized linear model with a negative binomial distribution (with log link) showed that semantic category was the factor with the strongest influence on sign functionality, with grammatical class, referential concreteness, and translucency also playing a part. No sign phonological characteristics were found to be of significant influence on sign use.

Conclusions: The meaning of a sign is the most important factor regarding its functionality (i.e., whether a sign is used in everyday communication). Phonological characteristics seem only of minor importance.

4.1. Introduction

Manual signing has been used for a long time to support the communication of people with intellectual disability (ID) and has become more common since the 1970s. Most applications of manual signing in this population can be defined as key word signing (KWS). KWS is a means of augmentative and alternative communication (AAC) in which the key words in a spoken sentence are simultaneously supported by manual signs (Grove & Dockrell, 2000). KWS is used in various subgroups of people with ID: in children, adolescents, and adults; in persons with mild and moderate to severe and profound ID; and in persons with ID from different aetiologies (e.g., Grove & Dockrell, 2000; Loncke, Nijs, & Smet, 1998; Marquardt, Sanchez, & Muñoz, 1999;). People with ID can produce signs themselves to support their language production, and their language reception can be supported when their interlocutors use KWS. Manual signing can serve as a temporary means of communication and aid in developing spoken language, or it can become the main communication form of a person with ID (Luftig, 1982). KWS is an unaided means of AAC, and it uses manual signs as symbols.

The aim of the present study was to determine which characteristics of manual signs affect the actual use of those signs by adults with ID. Literature is available on the influence of different sign characteristics on sign learning (acquisition, imitation, and retention), but little to no evidence is available relating sign characteristics to functional sign vocabularies of people with ID. Studying this relationship will not only contribute to our understanding of the everyday use of manual signs by people with ID, but will also increase our knowledge of their functional language and communication in general, as the processing of manual signs and spoken words are very closely related (Hickok, Bellugi, & Klima, 1998). Also, we will not only study modality-specific characteristics such as hand shape and movement, but referential (and thus modality-independent) characteristics such as concreteness and grammatical class as well. The findings might thus be applicable to other forms of AAC as well.

In the following literature review, first, we examine different KWS systems and the specific KWS system that is the subject of this study, the Flemish KWS system *Spreken Met Ondersteuning van Gebaren* (Speaking With Support of Signs; SMOG). Next, the different sign characteristics that have been studied in literature and that will be taken into account in the present study are discussed. Table 4.1 gives an overview of the operational definitions of some essential terms used in this literature review. Finally, the problem statement for this study is defined.

Table 4.1. Operational definitions of key terms.

Parameter	**Definition**
Sign learning	The acquisition, imitation, and retention of manual signs.
Sign functionality	The functional use of manual signs in everyday communication.
Sign phonology	The motor aspects of manual signs, like hand shape, location, and movement.
Iconicity	The relation of resemblance between a linguistic sign and the concept it represents.
Transparent signs	The relation between the sign and the concept it represents is guessable.
Translucent signs	The relation between the sign and the concept it represents is clear, once the relationship is known.
Obscure signs	The relation between the sign and the concept it represents is unclear.
Opaque signs	The relation between the sign and the concept it represents is arbitrary.

4.1.1. Key word signing

Manual signs from any sign language or sign system can be used with a KWS technique. A sign language is an integral language with a specific vocabulary and grammar, originated in the deaf community. A KWS technique can be applied to signs from any sign language (e.g., signs from American Sign Language [ASL] in Marquardt et al., 1999; and signs from British Sign Language [BSL] in Grove & Dockrell, 2000). A sign system however, is a limited set of signs usually designed specifically for a certain population, like people with ID. Examples include Madge Skelly's system of American Indian signs (Amer-Ind) in the United States (Campbell & Jackson, 1995), SMOG in Flanders (Loncke et al.,1998), and the Simplified Manual Sign Communication System in the United States (Bonvillian et al., 2008). Signs in these sign systems are often based on signs from sign languages but usually have certain characteristics simplified (e.g., hand shapes and movements in SMOG, Loncke et al.,1998; see further for more details). The sign sets of these sign systems are limited, from about 200 (Campbell & Jackson, 1995) to about 1,000 signs (Bonvillian et al., 2008).

The sign system studied in this study is the Flemish KWS system SMOG, developed in the 1980s by Loncke et al. (1998) for adolescents with ID and behavioural problems. The target population has been broadened to both children and adults with communication problems originating from ID, language impairments, autism spectrum disorders, acquired brain damage, and so on. The SMOG lexicon consists of 507 signs. These signs stand for 507 concepts, which can be found in Appendix B. The concepts have been chosen in order to be functional for a population of children and adolescents with ID. Most of the 507 signs are based on signs from *Vlaamse Gebarentaal* (VGT, Flemish Sign Language), but an attempt has been made to simplify some signs in order to reduce their motor complexity. Because only anecdotic information is available about these simplifications, a first step in the current study was to find out more about the nature of the SMOG signs and the modalities that have been adapted. SMOG is widely used in both children and adults with ID in Flanders, the northern Dutch-speaking part of Belgium with over 6 million inhabitants. Paramedics, psychologists, teachers, and support workers who wish to teach SMOG to their clients can attend a SMOG course in which all 507 signs, supplemented by extensive information about KWS and the correct application and implementation of the system, are learned. A survey study among all 297 residential and day care programs for adults with a congenital ID (without uncorrected visual or auditory impairments) in Flanders revealed that KWS is used in 51.2% of the programs and that all those programs use SMOG as their KWS system (Meuris, Maes, & Zink, in press).

The most important motivation for creating separate sign systems for people with ID is the presumption that some signs from sign languages are too difficult for this population (Bonvillian et al., 2008 ;Loncke et al., 1998). This presumption has been based on research on the characteristics of signs, mostly from ASL, and their influence on sign acquisition, imitation, and retention. A brief overview of this literature is given next. Most studies have been performed in a population of both hearing and deaf children and adults, with only limited studies in children and adults with ID. The literature that is available concerning people with ID also only addresses sign learning (acquisition, imitation, and retention), and does not address functional sign use in a communicative situation (DePaul & Yoder, 1986). Three groups of sign characteristics have mainly been studied and are discussed in this article: sign phonological, iconic, and referential characteristics. First, literature concerning typically developing children and adults with or without hearing loss will be discussed. If available, this will be complemented by literature concerning our target population, people with ID. We chose to include the former studies in a typically developing population because, for many parameters, this is the only information available. However, we have to bear in mind that we cannot assume the information from these studies to be directly applicable to people with ID. For each parameter within a sign characteristic group, the available literature concerning its influence on sign learning will first be discussed. No literature concerning the influence of the different sign characteristics on functional sign use has been found.

4.1.2. Sign characteristics

4.1.2.1. Sign phonological characteristics

Sign phonology refers to the equivalents of phonemes in signed languages. One of the first authors to study sign language was Stokoe in 1960 (Stokoe, 2005). He defined three phonological parameters to describe signs: **hand shape**, **location,** and **movement**. Two more parameters were added later: **orientation** and **nonmanual expression** (Grove, 1990). For each of these five parameters, literature concerning their acquisition and influence on sign learning will be described. No literature on their influence on functional sign use could be found.

Hand shape acquisition mostly has been described in terms of the acquisition age of the motor components that are necessary to perform certain hand shapes in typically developing children (Boyes Braem, 1990; Daniloff & Vergara, 1984; Doherty, 1985). Boyes Braem (1998) roughly confirmed her proposed hand-shape learning stages by applying them to the sign acquisition of a young deaf child, which was repeated by McIntire (1977) and Von Tetzchner (1984). Holmes and Holmes (1980) and Marentette and Mayberry

(2000) found a similar early hand-shape acquisition sequence in a young hearing child and a deaf child, respectively, as did Bonvillian and Siedlecki (2000) and Cheek, Cormier, Repp, and Meier (2001) in groups of young deaf and hearing children. McEwen and Lloyd (1990) suggested a slight alteration of Boyes Braem's stages, proposing that the first seven signs learned by typically developing children are: A, S, and O (fist hands); 5 and B (flat hands with fingers abducted and adducted); C (grasp hand with fingers adducted); and G (index finger and thumb in extension; see Figure 4.1). Siedlecki and Bonvillian (1997) also formulated a variant on Boyes Braem's stages by combining numbers on frequency of hand-shape production in a group of young children with those on accuracy and order of appearance. They proposed a first acquisition stage with the hand shapes 5 and G; a second stage with B and A (and S, which can be seen as a phonetic variant of A); and a third stage with O, C, and L. Ann (2005) largely confirmed these findings in Taiwan Sign Language. She assigned hand shapes to the groups *easy*, *hard*, or *impossible to perform*, based on hand physiology (mostly muscle function). All Boyes Braem's first learned hand shapes but the B hand shape were allocated to the easy hand-shapes category. The B hand shape, however, did prove to be among the seven most frequently occurring hand shapes in a Taiwan Sign Language corpus of 1,336 signs, as did G, C, A, and 5. Hand-shape acquisition in people with ID has not often been studied. A sign imitation task in adults with ID showed that the fewest errors were made against B, A, and 5 hands hapes (Loncke et al., 1998).

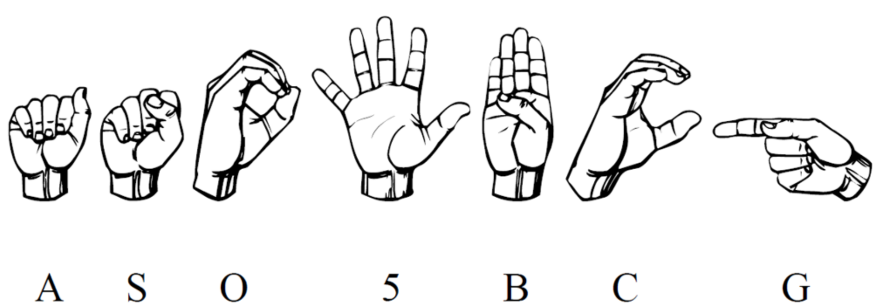

Figure 4.1. First acquired hand shapes according to McEwen & Lloyd (1990), based on Boyes Braem (1973).

Regarding **location**, signs produced in the neutral space, near or at the forearm, and near or at the head, were produced more often by a young hearing child than signs produced near or at the neck, trunk, upper arm, and wrist in supination (Holmes & Holmes, 1980). Similar findings were reported by Von Tetzchner (1984) in a young deaf child. Bonvillian and Siedlecki (2000) found that the locations produced first and most often by young children were the neutral space, chin, forehead, and trunk. The same was found by Marentette and Mayberry (2000) in a young deaf child and by Cheek et. al (2001) when studying early gestures and signs in young deaf and hearing children. No information concerning the acquisition of this parameter in people with ID was found.

The acquisition of the **movement** aspect of signs was studied by Dunn (1982, in Stowers, Altheide, & Shea 1987) and Dennis and colleagues (1982, in Doherty, 1985), taking a motor developmental analysis in typically developing children as a starting point. Concerning path movements, signs with movements towards the body were assumed to be easier than signs with movements away from the body. Signs performed at or towards the midline without crossing it also seemed to be easier. Concerning hand-internal movements, signs involving supination, pronation, circular movements, and finger wriggling were assumed to be most difficult. These findings were confirmed by Holmes and Holmes (1980), who looked at the characteristics of the first signs acquired by a hearing child. Bonvillian and Siedlecki (2000) and Cheek et al. (2001) found that the movements produced first and most often by both hearing and deaf children were up- and downward path movements, and closing and opening hand-internal movements. Mann, Marshall, Mason, and Morgan (2010) found that both deaf and hearing children produced more errors against hand-internal movements compared with path movements in a nonsense sign repetition task. The acquisition of this phonological parameter, to our knowledge, has not been studied in people with ID.

The relative importance of these three main phonological parameters (hand shape, location, and movement) to sign acquisition and retention has also been studied. For reviews of the early literature concerning this topic, we refer to Doherty (1985); Granlund, Ström, and Olsson (1989); and Grove (1990). In a group of nine young deaf and hearing children, location was produced more accurately than movement, and movement more accurately than hand shape (Bonvillian & Siedlecki, 1998, 2000). The first signs acquired by a young deaf child showed the same accuracy pattern (Marentette & Mayberry, 2000). Cheek et al. (2001) confirmed this finding in early gestures and signs in both deaf and hearing children. Mann et al. (2010) also found more errors were made with hand shape than with path movements by both deaf and hearing children in a nonsense sign repetition task. However, in other studies with both deaf children and hearing students, movement was the most difficult parameter to acquire (Doherty, 1985; Morgan, Barrett-Jones, & Stoneham, 2007). For both deaf and hearing adults, location seemed the most robust parameter for sign recognition (Orfanidou, Adam, McQueen, & Morgan, 2009). In adults with ID, observations of sign learning and sign imitation tasks suggest that the fewest errors were made with location, more errors with movement, and most with hand shape (Grove, 1990; Loncke et al., 1998).

To our knowledge, no literature has been published concerning the influence of the two remaining parameters, **orientation** and **nonmanual expression,** on sign acquisition, imitation, or retention. Recently, orientation has been described as a combination of hand part and location (van der Kooij, 2002), which might explain this lack of literature. Nonmanual expression refers to facial expressions like lip and tongue movements or brow movements, and body signals (Grove, 1990).

Besides location, hand shape, movement, orientation and nonmanual expression as the five most important phonological parameters, many other motoric dimensions have been identified and studied in relation to sign acquisition, imitation, and retention (Doherty, 1985; Grove, 1990). We will describe the five dimensions most frequently studied: **contact**, **manuality**, **repetition**, **complexity**, and **transition**.

The first additional dimension is **contact** (also called taction). Signs in which the hands make contact with each other or with the body are produced earlier and more frequently than signs without contact by young hearing and deaf children (Bonvillian & Siedlecki, 1998, 2000; Dunn, 1982 in Stowers et al., 1987; Holmes & Holmes, 1980; Marentette & Mayberry, 2000). In hearing children and adults, signs with contact are also learned more quickly and more easily (Lloyd & Doherty, 1983; Luftig, 1983). However, in a group of hearing adults, this facilitative effect of contact was not found (Granlund et al., 1989). Doherty (1985) suggested that the facilitative influence of contact was present only for people with relatively less “talent” for learning signs. Also, novel signers were found to show a preference for signs with contact and even to add contact to signs that were taught without contact (Doherty, 1985). The rationale for the facilitative effect of contact has been explained in two ways: first, contact seems to provide additional tactile feedback, which allows the signer to monitor the correctness of the sign and if necessary to adjust it; second, contact helps to specify the location of the sign (Doherty, 1985). In children and adults with ID, signs with contact also were learned more quickly and more easily (Doherty & Lloyd, 1983, in Doherty, 1985; Kohl, 1981).

A second additional dimension is **manuality** (also called handedness, number of hands required). Hamre-Nietupski (1977, in Doherty, 1985) was the first to suggest that one-handed signs are easier to produce than two-handed signs. Cheek et al. (2001) also found a preference for one-handed signs in the early gesture and sign production in young deaf and hearing children. However, children have been found to change one-handed signs into two-handed, symmetrical signs during sign acquisition (Doherty, 1985). Children also have shown to make mirror movements with the other hand when learning a difficult one-handed task during early stages of motor development (McEwen & Lloyd, 1990). Granlund et al. (1989) did not find a facilitative effect of manuality in hearing adults. Doherty and Lloyd (1983, in Doherty, 1985) found that, for adults with ID, the facilitative effect of one-handed signs applied only to highly translucent signs (see below under iconicity). These unclear findings regarding the influence of handedness can be related to indistinctness regarding the type of two-handed signs that were compared with one-handed signs. Three types of two-handed signs can be described (Battison, 1974): balanced signs (two hands are active, with identical hand shapes and movements that are symmetrical, synchronic, or alternating), unbalanced signs with identical hand shapes (one hand is inactive), and unbalanced signs with different hand shapes. Symmetrical signs were found to be learned more quickly and more easily by hearing adults (Granlund et al., 1989), but this seemed to correlate strongly with the translucency of a sign (see further under iconicity). In adults and children with ID, this facilitative effect of symmetry was found as well (Kohl, 1981; McEwen & Lloyd, 1990).

Repetition, or reduplication, is a third additional dimension. Theoretically, it was assumed that single movements were easier than repeated movements because of less motor complexity (Doherty, 1985; Granlund et al., 1989). However, most of the earliest signs produced by a young hearing child involved repetition (Holmes & Holmes, 1980). Furthermore, signs with repetition seemed easier for deaf and hearing children (Granlund et al., 1989), who also spontaneously were found to add repetition to single-movement signs (Doherty, 1985; Morgan et al., 2007). Nevertheless, in hearing adults, no facilitative effect of repetition of movement was found (Granlund et al., 1989). No information concerning the impact of repetition on sign learning in people with ID could be found.

A fourth dimension, **complexity**, refers to whether or not signs are composed out of multiple movements. It has been suggested in literature that signs with one movement are easier than signs with two or more movements (Doherty, 1985), but this has not been studied thoroughly.

Signs with **transition** (also called fluidity), the last additional dimension, have multiple hand shapes. Signs with one hand shape have been presumed to be easier than signs with a transition between two (or more) hand shapes (Doherty, 1985), but, as with complexity, this has not been studied.

A final important aspect is the interaction between these different phonological characteristics. The ability to produce components of a sign does not automatically induce the correct production of that sign (McEwen & Lloyd, 1990). This has mainly been studied with regard to phonological similarity, the degree to which signs share phonological aspects. Sign recognition and learning seem inhibited by phonological similarity in both deaf and hearing adults (Klima & Bellugi, 1979; Luftig, 1983; Poizner, Bellugi, & Tweney, 1981) and in children with ID (Griffith & Robinson, 1980).

In conclusion, although phonology of signs has been studied quite extensively, it seems that only the influence of sign phonology on sign acquisition, imitation, and retention has been studied, and mostly in both deaf and hearing young children and adults. To our knowledge, few to no studies have been performed on the influence of sign phonology on the functional use of signs in adults with ID.

4.1.2.2. Iconic characteristics

Besides their phonology, iconicity is also a much-discussed aspect of signs. Iconicity is a concept that is part of semiotics and has been extensively studied in different linguistic contexts (Tolar, Lederberg, Gokhale, & Tomasello, 2008). Iconicity can be defined as the way extralinguistic reality can be represented in linguistic structures (Pietrandrea, 2002), or in other words, a relation of resemblance between a linguistic sign and the concept it represents (Namy, 2008). On a continuum of iconicity, we can find transparent, translucent, obscure, and opaque signs (Markham & Justice, 2004). **Opaque** signs have an arbitrary relation with the concept they represent, for example the sign BROWN in SMOG (see Figure 4.2 for pictures of example signs).**Obscure** signs have an unclear relation with the concept they represent, for example the sign TO SHOP. The movement of the hands back and forth may be related to the act of giving money and receiving the purchased goods, but this relation is not very obvious to naive viewers. **Translucency** reflects the way the meaning of a sign is clear once the relationship between sign and concept is known. An example in SMOG is the sign UNDER. **Transparent** signs are guessable: anyone can guess what the sign means, for example TO EAT in SMOG. Iconicity is thus a concept that is strongly related to the etymology of a sign. Iconicity has also been described as the inverse of phonology on a linguistic continuum (Griffith & Robinson, 1980). Signs become less iconic over time because they conform more to structural, phonological, restrictions (DePaul & Yoder, 1986; Klima & Bellugi, 1979; Pietrandrea, 2002). However, already early on in the search for characteristics influencing the acquisition of signs in children with ID, iconicity was referred to as a possibly very important factor (Fristoe & Lloyd, 1977 in Luftig, Gauthier, Freeman, & Lloyd, 1980). Still, different discussions have been conducted in literature concerning the importance of iconicity.

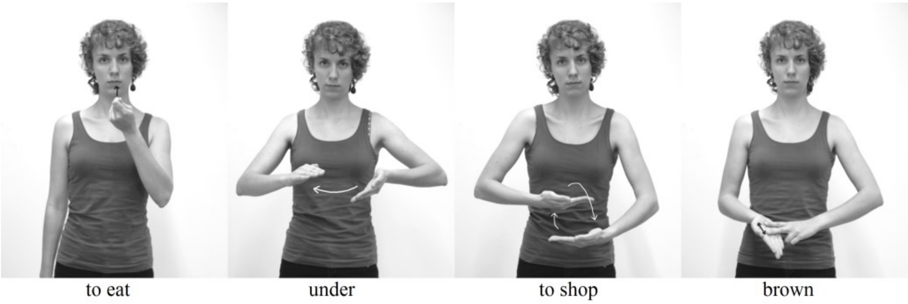

Figure 4.2. Examples of a transparent (TO EAT), translucent (UNDER), obscure (TO SHOP), and opaque (BROWN) sign in SMOG.

A ***first*** point of discussion is the operationalization of iconicity. **Transparency** has been referred to as linguistic iconicity, meaning a structural, universal characteristic of a sign (Griffith & Robinson, 1980; Griffith, Robinson, & Panagos, 1981). It is investigated by asking people to indicate the meaning of a sign via multiple choice, or to guess the meaning of a sign. The transparency of sign languages has been found to be quite low. For ASL and Signed Swedish, studied in both deaf and hearing children and hearing adults, 10%-25% of the signs have been found to be transparent (Granlund et al., 1989; Griffith et al., 1981; Lieberth & Gamble, 1991; Luftig, 1983; usually, a 50% criterion is used, with a transparent sign being a sign which has been guessed correctly by 50% or more of the participants). For Amer-Ind, transparency is much higher (42%-50% of the signs; Campbell & Jackson, 1995; Daniloff, Lloyd, & Fristoe, 1983), as this sign system was developed to consist of highly iconic signs.

Translucency, referred to as a psycholinguistic iconicity, has been described as any clue of association a learner makes between the sign and the referent, which does not have to be a visual similarity and can be time, culture, and experience bound (Griffith & Robinson, 1980; Griffith et al., 1981). Signs can be high in translucency while low in transparency, but transparent signs are always high in translucency (Luftig, 1983). Translucency is investigated by either asking people to state the relationship they perceive between a sign and its referent, or by asking them to rate this relationship on a Likert-type scale. A large spread in reported translucency of ASL exists, with estimations of the number of translucent signs at between 13% and 64.2%, depending on the method used and subjects (deaf children, hearing children, or hearing adults;

Griffith et al., 1981; Luftig, 1983; Luftig, Page, & Lloyd, 1983; Orlansky & Bonvillian, 1984).

A ***second*** point of discussion has been the influence of iconicity on sign acquisition and retention. When studying the early vocabularies of ASL-learning deaf children, no overrepresentation of iconic signs was found by Orlansky and Bonvillian (1984). This can be related to the development of the ability to recognize iconicity, which is not present at birth but has been found to develop during the second and third year of life (Namy, 2008; Tolar et al., 2008). On the contrary, according to Lloyd, Loeding, and Doherty (1985), initial lexicons of young children do contain more iconic signs. Vinson, Cormier, Denmark, Schembri, and Vigliocco (2008) found a significant correlation (r = –.463) between iconicity (rated on a 7-point-scale by 20 deaf adults) and age of acquisition (rated by the same participants) for 300 BSL signs. Also, in hearing adults, iconic signs, and more specifically translucent signs, were found to be acquired significantly better (Beykirch, Holcomb, & Harrington, 1990; Granlund et al., 1989; Lieberth & Gamble, 1991; Luftig & Lloyd, 1981; Luftig et al., 1983; Mills, 1984;). However, in other studies, no memory or recognition advantage for iconic signs could be found in both deaf and hearing adults (Bosworth & Emmorey, 2010; Klima & Bellugi, 1979; Poizner et al., 1981). Griffith and Robinson (1980) suggested that iconicity seems important mostly during the initial stages of sign learning and more to hearing than to deaf persons. For children and adults with ID, different studies have shown a facilitative effect of sign translucency on sign acquisition (Doherty & Lloyd, 1983 in Doherty, 1985; Goossens, 1983 in Doherty, 1985; Griffith & Robinson, 1980; Loncke et al., 1998; Luftig et al., 1983). Kohl (1981) and Marquardt et al. (1999), on the other hand, did not find a significant influence of iconicity on sign acquisition in children and adults with ID. These seemingly contradictory findings in the literature can partly be explained by different operationalizations of the theoretic concept iconicity. Although translucency has consistently been found to facilitate sign learning, transparency has not (Doherty, 1985; Luftig, 1982). Differences in degree of ID of the studied populations may also affect results. Orlansky and Bonvillian (1985) argued that the importance of iconicity in sign acquisition is related to the age and type of disability of the sign learners, as well as to the setting (experimental or home). DePaul and Yoder (1986) stated that many iconicity studies might be misleading because the signs are studied in isolation and not in a functional context. Also, research has mainly focused on the influence of iconicity on sign acquisition and retention (DePaul & Yoder, 1986). The influence of iconicity on functional sign use has, to our knowledge, not yet been studied.

4.1.2.3. Referential characteristics

The referential characteristics of a sign are all related to its meaning. A first aspect mentioned in literature is referential concreteness. Referents are concrete if they “can be envisioned in a psychological image” (Luftig & Lloyd, 1981, p. 49). Concreteness, determined using a 7-point rating scale, was found to facilitate sign learning in hearing adults (Mills, 1984), having a cumulative effect with translucency (Luftig & Lloyd, 1981). However, it was not found to contribute to sign learning in a group of people with ID by Luftig et al. (1983). A second referential aspect is grammatical class of the referent. It is not always easy to classify a referent as noun or verb, because many nouns represent objects that are closely related to movements of or on that object, as depicted by the sign (Bonvillian, Orlansky, & Novack, 1983). It has been assumed in the literature that signs depicting action patterns (action verbs or nouns for objects on which actions are performed) are easier to acquire (Grove, 1990). Action verbs have been found to be significantly more translucent than nouns for hearing children and adults (Luftig et al., ; Page, 1985). We are not familiar with any studies performed in people with ID regarding this referential sign aspect.

In summary, the influence of sign characteristics on sign learning has been mainly studied in ASL, and in typically developing hearing and deaf children and adults. Regarding **phonology**, hand shapes, locations, and movements seem to be acquired in a well-defined order in both deaf and hearing children. The easiest hand shapes, according to this order, also are imitated best by adults with ID. Location seems the easiest parameter, whereas hand shape is the most difficult parameter to acquire in both deaf and hearing children and students, as well as in adults with ID. As for the remaining phonological dimensions described, signs with contact and symmetry are produced earlier and more frequently and are learned faster by both hearing and deaf children and adults, as well as by children and adults with ID. For repetition, a facilitative effect was only found in deaf and hearing children. Less complex signs and signs without hand-shape transitions are assumed to be easier to learn, but this has not been studied. Regarding **iconicity**, translucent signs have been found to be acquired better by hearing adults, presumably mostly during initial stages of sign learning. For children and adults with ID, a facilitative effect of translucency was found as well. Finally, regarding the **referential characteristics** of a sign, concrete signs depicting action verbs have been found to be acquired better by hearing adults, but not by adults with ID.

4.1.3. Problem statement

The three groups of sign characteristics studied most in literature–sign phonology, iconicity, and referential characteristics–seem to influence sign acquisition, imitation, and retention to some degree and in certain populations. Evidence is not unambiguous, however, and the effect of these characteristics on everyday sign use of people with ID has not yet been studied.

Therefore, this article examines the relationship between sign characteristics and the reported functional sign vocabulary of adults with ID who use KWS as (one of) their main forms of communication. The signs from SMOG, a Flemish manual signing system (Loncke et al., 1998) are analysed with regard to the three groups of characteristics described. Sign characteristics are related to sign functionality, operationalized as the number of adults reported to use each sign in functional, daily communication. All sign characteristics are fitted into a regression model to determine the relative weight of the different characteristics in relation to sign functionality. This will broaden our knowledge on the use of manual signs by adults with ID, and how this is influenced by phonological, iconic, and referential sign characteristics.

4.2. Methods

The study protocol was approved by the ethical board of the University Hospitals Leuven, Belgium.

4.2.1. Sign characteristics

This study comprises the 507 basic signs of the Flemish KWS system SMOG (Loncke et al., 1998; see Appendix B). The 507 signs were analysed with regard to 10 phonological parameters, two iconic parameters, and three referential parameters (see Appendix C, a summary is provided in Table 4.2). The procedure for determining each parameter is described below.

4.2.1.1. Phonological characteristics

The different phonological aspects of the signs were determined based on the phonological dependency model described by van der Kooij (2002) and adapted for VGT by Demey (2005). In this model, the different categories within phonological parameters, called distinctive features, are determined using minimal pairs . As in spoken language phonology, minimal pairs refer to pairs of signs with a difference in meaning that differ in only one phonological parameter. This method differs from phonetic models such as the Hamburg Sign Language Notation System (HamNoSys, Hanke, 2004), which includes all possible phonetic expressions of a parameter without taking into account their phonological relevance. For computational reasons, some variables of the phonological dependency model were simplified by grouping similar categories. All parameters taken into account and their different values can be found in Appendix C. As can be seen in the resume in Table 4.2, all five main phonological parameters and the five additional dimensions described in the literature were included. The analysis was made using video clips of the 507 signs. An experienced speech-language pathologist (SLP) produced the signs. Two video cameras (Sony DSR-PD170P) were placed in an angle of 90°, and all signs were filmed both frontal and lateral. The two images thus obtained were placed next to each other using a split-screen configuration in Final Cut Pro (Version 9). An experienced SLP, in consultation with one of the authors of SMOG (M. Nijs, personal communication, September 19, 2012), allocated all signs to the appropriate category for each parameter by playing the clips multiple times at low speed. The phonological analysis was done by mutual agreement rather than independently by the two raters, with one of the two raters being one of the developers of SMOG.

Table 4.2. Sign characteristics used to analyse the 507 signs.

Sign characteristic	**Type of variable**
PHONOLOGICAL CHARACTERISTICS	
Location	Categorical
Hand shapes	Categorical
- dominant and nondominant hand	
- before and after transition	
Movement	Categorical
- direction of movement	
- shape of movement	
- hand-internal movements	
- crossing	
Orientation	Categorical
- static type (orientation of the movement)	
- static (part of hand oriented towards static type)	
- dynamic (change in orientation)	
Nonmanual expression	Binary
Contact (type)	Categorical
Manuality and symmetry	Categorical
Repetition	Binary
Complexity	Binary
Transition	Binary
ICONIC CHARACTERISTICS	
Transparency	Continuous
Translucency	Continuous
REFERENTIAL CHARACTERISTICS	
Concreteness	Continuous
Grammatical class	Categorical
Semantic category	Categorical

4.2.1.2. Iconic characteristics

Both transparency and translucency, the two major aspects of iconicity, were determined for the studied signs. They were measured in undergraduate students in speech and language pathology and audiology or pedagogical sciences. Students with knowledge of KWS or sign language were excluded from participation. In total, 467 students participated, of which 431 (92.29%) were female, with a median age of 18 years (minimum 17, maximum 24). Of this group, 199 took part in the transparency study, and 268 in the translucency study. In order to offer the exact same sign production each time in the study, movie clips of all 507 signs were made, as explained in the Phonological characteristics section. Due to technical errors, 10 signs were excluded from the iconicity study, resulting in 497 signs included. The 497 sign-clips were randomized over 10 lists using Research Randomizer (Urbaniak &

Plous, 2010), with each list containing 49 or 50 signs. Two sets of lists with a different internal order, A and B versions, were generated. Each sign was shown twice, with a black screen lasting 1 second played in between two clips. A pilot study was conducted with 8 SLPs and audiologists without any KWS or sign language experience. Thus, the procedure was fine-tuned for use in the students.

In the **transparency** study, students were divided into groups of 10-15 and were shown one of the 10 generated lists of 49 or 50 signs. Each group was randomly assigned a list, and the A or B version of that list. This way, each sign was evaluated by 20 to 30 students, once in the A version of the list and once in the B version of the list. Students were instructed to look at each sign carefully and try to guess what that sign would mean. A score sheet was developed to write down the meaning of the signs. Students were encouraged to write down as few words as possible, preferably a single word. A new sign was only shown when all students finished writing. The transparency responses were judged as being correct (score 1) or false (score 0) by comparing them to a list of target answers for each sign. These answers consisted of the main concept and all possible synonyms, first-degree hypernyms, and hyponyms (a hyponym is a subtype or instance of a hypernym, which includes the hyponym in its semantic field; for example: *dog* is a hyponym of its hypernym *animal*) according to the Dutch synonym dictionary (Van Dale, 2007). We thus developed a very liberal scoring system.

The procedure for the **translucency** study was similar: Students were randomly assigned to groups of 10-15 and were shown one of the 10 generated lists in the A or B version. In this task, however, the students were given the meaning of each sign. The main concept of each sign was read out loud and was given on their score sheet. The students were asked to indicate, on a 6-point Likert scale, how clear they found the relationship between the sign and the concept it represented.

Both transparency and translucency scores per sign were converted to a percentage for easier comparison. The transparency of a sign was defined as the percentage of students who guessed the meaning correctly, and the translucency as the mean score on the 6-point scale as indicated by the students, expressed as a percentage.

4.2.1.3. Referential characteristics

The referential characteristics of the signs that were examined in this study are concreteness, grammatical class, and semantic category. The main target concepts of the 507 signs, as described by the authors (Loncke et al., 1998) were used for this analysis. This implies an inaccuracy, because many signs can stand for many concepts. Still, for analytical reasons, only the main concept was taken into account. An overview of the referential characteristics can be found in Appendix C. Concreteness of sign was determined using the MRC Psycholinguistic Database (Wilson, 1988), a large online lexical database for English. The levels of concreteness in this database are taken from Gilhooly and Logie (1980, in Wilson, 1988) and were determined by 35 students' ratings on a 7-point scale. The English translation of the main concept for each sign was used to look up this concreteness. Concreteness ratings were converted to percentages for easier comparison. Grammatical class was attributed using the Dutch dictionary (Van Dale, 2008). Each sign was then allocated to a semantic category by five SLPs via mutual agreement. This resulted in 30 semantic categories, which were then grouped into 17 categories for computational reasons (with 30 categories being too many in order to be able to calculate a generalized linear model; see below). For example: the categories fruit, vegetables, candy, desserts, other food, and drinks were grouped into one category of food and drinks. The different signs per category are displayed in Appendix B.

4.2.2. Sign functionality

Besides the sign characteristics, we also studied sign functionality. By functionality, we mean the frequency in which the sign occurs in the functional sign vocabulary of a KWS user. Functional sign vocabulary is defined as the set of signs that are used in everyday communication. To collect information about the functional vocabulary of adults with ID using KWS, a questionnaire was filled out by their support workers. This study included 119 adults with ID, using KWS as one of their main forms of communication. They were recruited among the participants of a previous survey study by the authors, concerning the use of KWS in residential and day care programs for adults with ID (Meuris et al., in press). The only inclusion criteria were being an adult (18 years of age minimum), having a congenital ID, using KWS as a main means of communication (since at least 1 year and producing a minimum of 10 signs), not having an uncorrected visual or auditory impairment, and making use of a day care or residential program in Flanders. Only adults with ID for whom an informed consent was received from the adults themselves, their parent or caregiver, and one of their support workers were included. Thus, 119 adults with ID participated in this study, 53.78% of whom were female. They had a mean age of 40.23 years (minimum 18, maximum 77; *SD* = 10.17) and a mean mental age (based on the most recent IQ test available in their personal file) of 50.54 months (minimum 14, maximum 108; *SD* = 19.09). Additional physical disabilities were present in 9.24% of the adults, (corrected) hearing impairments in 21.85%, autism spectrum disorders in 7.56%, behavioural disorders in 12.61%, and dementia in 4.20% (information obtained from the personal files of the participants, as diagnosed by their physicians and/or psychologists). Of the 48.74% adults for whom the aetiology of their ID was known, most had Down syndrome (38.66%), with the remainder 10.08% having various other syndromes (e.g., Dandy-Walker, Fragile X, and Marfan).

For each adult with ID, a support worker filled out a questionnaire. This support worker needed to have known the adult for at least 1 year, have had regular contact with the adult, and have had at least 1 year experience in using KWS. A questionnaire, inspired by the MacArthur-Bates Communicative Development Inventories (Dutch version: *N-CDIs Lijsten voor communicatieve ontwikkeling*; Zink & Lejaegere, 2002) was developed to gather information concerning the functional sign vocabulary of the participants. The questionnaire consists of a checklist of the referents of the 507 Flemish signs. Respondents were asked to indicate all signs that the adult with ID used during spontaneous, functional communication. They were asked to base their answers on their experience with the client during the past few weeks. At this time, whether or not the sign was combined with speech was not taken into account. This resulted in a production score per adult (the total number of signs indicated; minimum 0, maximum 507) and a functionality score per sign (total number of times a sign was indicated; minimum 0, maximum 119).

4.2.3. Data analysis

Normality of the outcome variables (production score per adult and sign functionality) was assessed using the Shapiro-Wilk test. Both showed a nonnormal distribution (W = 0.974, p = .020, and W = 0.948, p < .001, respectively), so nonparametric tests were used. The relationships between the adult characteristics and the production scores per adult were calculated using Spearman's correlation coefficients (for the continuous variables age and mental age), Mann-Whitney tests (for the binary variables gender and additional disabilities), and a Kruskal-Wallis test (for the categorical variable aetiology of ID). The individual relations between the sign characteristics and the sign functionality were calculated using Spearman's correlation coefficients (for the continuous variables transparency, translucency, and concreteness), Mann-Whitney tests (for the binary variables nonmanual expression, repetition, complexity, and transition) and Kruskal-Wallis tests (for the categorical variables location, hand shape, movement, orientation, contact, manuality and symmetry, grammatical class, and semantic category). Sign characteristics that were found to have a significant relationship with the sign functionality were modelled using a generalized linear model (GLM) with a negative binomial distribution (log link). A GLM is a generalization of linear regression for variables that have a nonnormal distribution. For a count outcome variable, such as our variable sign functionality, typically a Poisson distribution can be applied. We had to choose a negative binomial distribution with a log link function, however, because a Poisson distribution showed overdispersion (the variance exceeded the mean in the dataset; see Nelder & Wedderburn, 1972, for more information). Results were considered statistically significant at p < .05. Because multiple hypotheses were tested, for conservative reasons, Bonferroni corrections were applied.

4.3. Results

4.3.1. Sign characteristics

The characteristics of the 507 signs can be found in Appendix C. Of the 507 signs, 16 are complex (composed) signs. Many phonological parameters could be determined only for the 491 noncomposed signs in the corpus, because composed signs often combine multiple categories within one parameter. As can be seen in Appendix C, the SMOG corpus displays a large variety in locations, hand shapes, movements, and orientations. Of the four different locations included, a significant percentage (43.79%) of the signs are produced in the neutral space. We found 23 different hand shapes in the 507 signs (see Appendix A), with the most frequently occurring being a flat hand (B; 24.46% of dominant hand shapes) or fist (A, S, and thumb up; 18.93% of dominant hand shapes). The most frequently occurring movements combine multiple directions (25.25%) or are directed from high to low (16.90%), predominantly with a straight movement shape (46.03%). Hand-internal movements do not occur frequently (85.13% of the signs show no hand-internal movements), and most of the signs are produced at the midline (51.53%) or do not cross the midline (40.33%). Most signs are oriented toward the neutral space (51.12%), with a combination of hand and finger orientations (23.42%) or the ulnar side of the hand oriented toward the end of the movement (17.92%), and no change in orientation (70.06%). Only few signs (9.66%) require nonmanual expression, which, however, does not mean that nonmanual expression cannot occur when performing the other 90.34% of the signs. For four of the five main sign phonological parameters (hand shape, movement, location, and orientation), and for 446 signs (88.0% of the total corpus), a comparison between the SMOG corpus and the same lexicon in VGT could be made using the available sign phonology information in the VGT online dictionary (*Woordenboek Vlaamse Gebarentaal*, 2004). This comparison revealed that 68.2% of the SMOG signs have an VGT equivalent with the same (dominant) hand shape, movement, location, and orientation. For the remaining 31.8% of the signs, the adaptations most commonly made are a different hand shape (for 20.2% of the signs) and/or movement (for 15.9% of the signs) in SMOG compared with VGT. Replacements of other hand shapes by B, G, C, or A/S (S is seen as a phonetic variant of A) hand shapes account for 58.9% of all hand-shape adaptations. With regard to this hand-shape parameter, the 23 hand shapes found in the SMOG corpus correspond to 23 (74.2%) of the 31 hand shapes found in a corpus of 2,424 VGT signs (analysed by Demey, 2005). This comparison between SMOG and VGT suggests that the SMOG corpus, although not identical, does show many similarities to the same lexicon in VGT.

With regard to the remaining phonological dimensions, almost half of the signs display contact between both hands or the hand(s) and the body (48.68%), with most of the contact being of a continuous nature (11.41%). Fewer than half of the signs are unilateral (46.23%). Most bilateral signs are balanced, symmetrical signs (23.42%). Most signs (58.86%) involve no repetition of movements and no transition of hand shapes (89.00%).

The iconic characteristics were determined for 497 signs. The mean transparency of these signs was 22.45% (*SD* = 31.22), and the mean translucency was 54.48% (*SD* = 26.61). When using a 50% criterion, 110 (22.1%) of the signs were judged to be transparent, and 345 (69.4%) were judged to be translucent. Also, 224 signs were not guessed by any participant in the transparency task (transparency of 0%). Most of the referents of the 507 signs are nouns (54.83%) or verbs (23.08%), and concern hobby and free time (14.60%), or food and drinks (12.62%). Referential concreteness could be determined for 429 signs, with a mean concreteness of 64.80% (*SD* = 20.70).

4.3.2. Sign functionality

The sign vocabulary questionnaire was filled out for 119 adults with ID. They could spontaneously produce a mean of 188.64 of the 507 signs (minimum 10, maximum 499, *SD* = 104.17). The sign production score per adult was significantly related to their mental age (adults with a higher mental age produced more signs; $r = .387$, $p<.001$) but was not significantly related to their age ($r = -.247$, $p = .080$), gender ($U = 1552.5$, $p = .269$), or aetiology of their ID, $\chi^2(11) = 11.863$, $p = .374$, nor to having additional physical ($U = 538.5$, $p = .611$), auditory ($U = 1200.5$, $p = .962$), or psychological disorders (autism spectrum disorders: $U = 316$, $p = .072$; behavioural disorders: $U = 669$, $p = .374$; dementia: $U = 209.5$, $p = .317$).

The sign functionality for each sign can be found in Appendix B. The mean sign functionality (i.e., how many of the 119 participating adults produced the sign spontaneously) was 45.43 (minimum 1, maximum 109; SD = 28.11). In a first step, we looked at the relation of each individual sign characteristic with sign functionality. This statistical analysis can be found in Appendix D. From all phonological sign characteristics included in this study, only location, $\chi^2(3)$ = 20.276, p = .003, was statistically significantly related to sign functionality. Mean ranks showed that signs produced on and/or near the head had a higher sign functionality than signs produced on the nondominant hand, which in turn had a higher sign functionality than signs produced on the body, which finally had a higher sign functionality than signs produced in neutral space. Repetition had a marginally significant relation with sign functionality (U = 24320.00, p = .066), with signs with repetition of movement having a larger sign functionality. Regarding the iconic characteristics of the signs, both transparency and translucency correlated significantly and moderately with sign functionality (r = .282, p < .001, and r = .228, p < .001, respectively). The referential sign characteristics also were all significantly related to sign functionality. Concreteness and sign functionality correlated moderately (r = .360, p < .001). The significant relationship between sign functionality and grammatical class, $\chi^2(5)$ = 39.942, p < .001, reflects that nouns and verbs had the highest sign functionality and prepositions and pronouns the lowest. Semantic categories with the highest sign functionality were food and drinks, and traffic and vehicles; the categories with the lowest sign functionality were place indicators and quantities and measures, $\chi^2(16)$ = 104.150, p < .001 (see Appendix B for mean sign functionality scores per category).

In a next step, to further examine the nature of these relationships, the variables (marginally) significantly related to sign functionality were related to each other. As can be seen in Table 4.3, transparency and translucency were highly correlated. Concreteness was significantly related to location. Mean ranks reflected that signs located on/near the head were more concrete than signs located on the nondominant hand, which in turn were more concrete than signs located on the body, which finally were more concrete than signs located in neutral space. Although repetition did not relate significantly to any of the other variables, both grammatical class and semantic category were significantly related to location, transparency, translucency, and concreteness, and to each other. For location, standardized residuals showed, for example, that nouns were produced significantly less often in neutral space, and adjectives were made significantly less often at the hand. Signs concerning clothes were made significantly more often near the body, signs for body and illness were made more often at the head and body, and signs for animals at the head. Mean ranks showed that, both for transparency and translucency, the most iconic signs were prepositions and verbs, whereas the least iconic signs were nouns and adjectives. Semantic categories with the highest iconic signs were politeness and obedience, and feelings; the least iconic signs were time indicators and food and drinks. The most concrete signs, according to mean ranks, were nouns and verbs and concerned animals and food and drinks. The least concrete signs were prepositions, adverbs, interjections, conjunctions, and numerals and concerned place indicators, and quantities and measures.

Table 4.3. Relationships between variables significantly related to sign functionality.

	Transparency	Translucency	Concreteness	Grammatical Class	Semantic category	Repetition
Location	$\chi^2(3)$ = 3.247, p = 1.000	$\chi^2(3)$ = 1.434, p = 1.000	$\chi^2(3)$ = 34.042, p < .001*	FET = 33.991, p = .019*	FET = 181.237, p < .001*	$\chi^2(3)$ = 5.324, p = 1.000
Transparency		r = .758, p < .001*	r = –.063, p = 1.000	$\chi^2(5)$ = 54.525, p < .001*	$\chi^2(16)$ = 64.658, p < .001*	r_{pb} = .006, p = 1.000
Translucency			r = –.113, p = 1.000	$\chi^2(5)$ = 49.881, p < .001*	$\chi^2(16)$ = 86.176, p < .001*	r_{pb} = –.055, p = 1.000
Concreteness				$\chi^2(5)$ = 249.29, p < .001*	$\chi^2(16)$ = 272.991, p < .001*	r_{pb} = .047, p = 1.000
Grammatical class					FET = 577.974, p < .001*	$\chi^2(5)$ = 12.116, p = .698
Semantic category						$\chi^2(16)$ = 40.445, p = .141

Note. FET = Fisher's exact test.
* p < .05 (Bonferroni correction applied).

Finally, to explore the relationships of these variables with sign functionality in relation to each other, a generalized linear model with a negative binomial distribution (with log link) was applied. Because the transparency and translucency variables were highly correlated, only one was included into the model. Translucency has been described in literature as being more relevant to sign use than transparency, therefor translucency was chosen. As for the categorical variables location, grammatical class, and semantic category, we decided to include them into our model despite their significant relation to the other variables. After all, neither chi-square nor Kruskal-Wallis tests provide information on the strength of the relationship between two variables. Repetition was also included because it did not correlate with any of the other variables. First, all six variables were included in the model. A model was fitted with a goodness-of-fit of 1.141 (deviance/*df*) to .991 (Pearson χ^2/df) and a log likelihood of -1,834.691. The model showed that, when controlling for the remaining variables, location and repetition did not contribute significantly to sign functionality. A new, more parsimonious model was fitted, including semantic category, grammatical class, concreteness, and translucency. This model had a goodness-of-fit of 1.127 (deviance/*df*) to .994 (Pearson χ^2/df) and a log likelihood of -1,884.862. The likelihood ratios and *p* values for the variables can be found in Table 4.4.

Table 4.4. Negative binomial regression model.

Variable	**Likelihood ratio χ^2**	**Degrees of freedom**	**Significance**
Intercept	160.060	1	$p < .001$*
Semantic category	49.978	16	$p < .001$*
Grammatical class	13.801	5	$p = .017$*
Concreteness	17.796	1	$p < .001$*
Translucency	29.336	1	$p < .001$*

* p < .05

The individual parameters show that, although concreteness and translucency contribute significantly to sign functionality, their contribution is only small when controlling for the other variables semantic category and grammatical class (Exp(B)=1.012 and 1.007, respectively). The estimated means (EM) of the categorical variables show that food and drinks was the semantic category with the highest contribution to sign functionality (when controlling for the covariates: translucency fixed at 55.249, concreteness at 64.813), with signs from this category being significantly more functional (EM = 54.678; 95% confidence interval [40.610, 68.746]) compared with the least functional signs, concerning nature (EM = 25.754; 95% confidence interval [17.259, 34.249]). The most functional grammatical class was verbs (EM = 51.336; 95%

confidence interval [42.988, 59.685]), compared to prepositions being the least functional class (EM = 20.105; 95% confidence interval [6.319, 33.891]).

4.4. Discussion

To our knowledge, this is the first study to report the relationship between different sign characteristics and sign functionality, by which we refer to the functional, daily use of a sign by a KWS user. First, the Flemish KWS system SMOG was characterized with regard to sign phonological, iconic, and referential characteristics. We found that the system shows many similarities to signs from sign languages (VGT and ASL) on both a phonological and iconic level. When comparing the SMOG signs to VGT signs, phonological sign adaptations were made to 31.8% of the signs, with the remaining 68.2% of the SMOG signs having the same hand shape, location, movement, and orientation as their corresponding VGT sign. The most frequently occurring adaptations made were replacing other hand shapes with the hand shapes B, G, C, or A/S. These hand shapes are among the first acquired, as described by Boyes Braem (1990) and Siedlecki and Bonvillian (1997) in typically developing children, which probably motivated these adaptations. This way, certain signs might be easier to learn by persons with motor difficulties. However, a range of 23 different hand shapes are still present in the SMOG corpus. Also, with regard to location, movement, and orientation, many different expression forms can be found in SMOG (see Appendix C). We can conclude that adaptations have been made to some signs with the intention to make them phonologically easier; however, the complete corpus of 507 SMOG signs does still show quite some phonological complexity. With regard to the iconicity of the SMOG corpus, with 22.1% of the signs judged to be transparent and 69.4% judged to be translucent, this seems comparable to that reported in ASL (with a transparency of 10%-25% and a translucency of 13%-64.2%, Griffith et al., 1981; Lieberth & Gamble, 1991; Luftig, 1983; Luftig et al., 1983; Orlansky & Bonvillian, 1984). The transparency and translucency rates do relate more to the upper limit of those reported in ASL, so one could speculate that the corpus is slightly more iconic than a corresponding ASL corpus would be. However, this is not easy to estimate because iconicity relates significantly to the referential characteristics of a sign, and many different referents were included in the different ASL studies reviewed.

Next, sign phonological, iconic, and referential characteristics were studied in relation to the functionality of the signs in a Flemish KWS system for adults with ID. When including all variables that were significantly related to sign functionality in a generalized linear model, we found only translucency, concreteness, grammatical class, and semantic category to be significant predictors of sign functionality.

Iconicity, and more specifically translucency, has been described frequently in literature as a very important factor concerning sign acquisition and recall (Beykirch et al., 1990; Doherty, 1985; Granlund et al., 1989; Griffith & Robinson, 1980; Lieberth & Gamble, 1991; Luftig, 1982; Luftig & Lloyd, 1981; Luftig et al., 1983; Mills, 1984). The current data suggest that translucency remains an influencing factor, not only for sign acquisition, but also for sign functionality. It seems as if highly translucent signs also are more functional. Because translucency and transparency correlate highly, no statement can be made regarding the relative importance of one over the other. However, because translucency measures give a more nuanced picture than transparency measures (many signs are not guessed correctly by anyone, resulting in a transparency of 0%), and because translucency seems clinically more relevant (signs are always paired with their meaning when using KWS), it seems that translucency is the more relevant factor. This strengthens the recommendation to choose signs high in translucency when offering new signs to a person who uses KWS, whenever this would be an option.

A second influencing factor is the referential concreteness of the sign. Luftig and Lloyd (1981) and Mills (1984) found a facilitative effect of referential concreteness on sign learning in hearing students, but this was not found in people with ID (Luftig et al., 1983). The current data did show a significant relationship between concreteness and sign functionality in adults with ID. This suggests that although concrete signs might not be easier to learn for this population, they seem to be more functional.

Grammatical class of the referent also influenced sign functionality, with verbs being the most functional signs. This can be related to the assumption that action verbs are easier to acquire (Grove, 1990), and to the fact that the verbs in our sign corpus are rated with a higher translucency (comparable to what Luftig et al. [1983] and Page [1985] found).

The sign characteristic with the highest influence on sign functionality was semantic category. This refers to the meaning of the sign and does seem very logical: What a sign means is much more important to its functionality than what phonological or iconic characteristics it possesses. When the need exists for a sign with a particular meaning, an adult with ID will most likely try to use that sign. Different authors have stated that the most important factor in selecting a sign vocabulary is that the signs are functionally relevant to the person using the signs (Doherty, 1985; McEwen & Lloyd, 1990; Page, 1985). Signs concerning food and drinks seem to be the most functional signs, which can be related to food and drinks being very essential and important aspects of everyday life for many people with and without ID. This indicates that it is important to offer signs whose content is relevant to adults with ID, in close relationship with their everyday life.

In contrast to literature concerning the influence of many phonological sign characteristics on sign acquisition, imitation, and retention, no significant relationship between phonological sign characteristics and sign functionality in adults with ID for the Flemish KWS system SMOG was found when controlling for iconic and referential characteristics. This does accord with the findings of Granlund et al. (1989) in typically developing adults. Not motor requirements, but translucency, concreteness, grammatical class, and mostly semantic category seem to be important variables concerning sign functionality in the present study. The discussion of the relative importance of the characteristics of signs compared with their functionality has been conducted previously in literature. Some authors have argued that too much attention was given to iconicity, to the prejudice of phonology and functionality (DePaul & Yoder, 1986). This current study, however, also reduces the importance of phonological sign characteristics. The desire to communicate and the motivation of a person with ID are of great influence on the functional communication obtained using manual signs (Luftig, 1982). Motivation, opportunities, and appropriate training can make people from whom it is not expected according to their cognitive or motor skills produce a whole range of intelligible signs (McEwen & Lloyd, 1990). This contributes to the idea that phonological sign characteristics, although of influence on sign acquisition, do not seem to play the main part in functional sign use.

A first possible weakness of this study is the fact that the SMOG system, although consisting of signs with a large variety of hand shapes, movements, locations, and orientations, does include some signs that were phonologically adapted. We therefore cannot be sure that a similar result would have been obtained had these adaptations not been made. Possibly, the absence of an influence of phonological characteristics on sign functionality could be related to these phonological adaptations that have already been made in an effort to ensure that phonological difficulty would not affect the learning of the signs. On the other hand, because many of the studied signs did display the same phonological characteristics as their equivalent VGT signs, this cannot be concluded with certainty.

A second possible weakness is that this study is based on questionnaire data. The functionality of the signs was determined by support workers who indicated all signs an adult with ID produced in his or her spontaneous communication. This self-report data could imply some inaccuracies. Also, it does not give us information regarding the quality of the produced signs. However, this is one of the first studies to actually look at the functionality of a sign rather than at its acquisition in relation to its characteristics. A first suggestion for further research would be to replicate this study in a group of people who use a different sign system. Of course, although the SMOG system does display a large range of used hand shapes, locations, movements, and orientations, some of the signs in the system were adapted compared to their VGT equivalents. It would be very interesting to see whether the same results would be found when studying other KWS systems. A second suggestion is to study the functionality of sign use in an observational design. When observing adult KWS users in their everyday life, sign functionality could also be related to other important factors such as the combination of sign and speech and the communicative functions used. This could greatly enhance our insight in the functionality of KWS use in adults with ID.

4.5. Conclusion

This is one of the first studies to look at the influence of sign characteristics on the functional sign use of adults with ID. The most important factor with regard to sign functionality in the Flemish KWS system SMOG proved to be the meaning of the sign. If an adult with ID needs a sign with a certain meaning in a functional communicative situation, chances are high that the adult will try to produce the sign. Grammatical class, translucency of the sign, and referential concreteness also played an important role for our studied population. Phonological characteristics were found to be only of minor importance with regard to sign functionality for adults with ID using the Flemish KWS system.

Chapter 5
The relation between client characteristics and the functional key word signing use of adults with intellectual disability: observation study

The content of this chapter has been described in:

Meuris, K., Maes, B., and Zink, I. (2014). Evaluation of language and communication skills in adult key word signing users with an intellectual disability: Advantages of a narrative task. Research in Developmental Disabilities 35(10), 2585-2601.

Abstract

The evaluation of language and communication skills in adults who use augmentative and alternative communication (AAC) in general and key word signing (KWS) in particular, can be an elaborate task. Besides being time-consuming and not very similar to natural communication, standard language tests often do not take AAC or KWS into account. Therefore, we developed a narrative task specifically for adults with intellectual disability (ID) who use KWS. The task was evaluated in a group of 40 adult KWS users. Outcome measures on the narrative task correlated significantly with measures of standard language and communication tests for verbal language, but not for use of manual signs. All narrative measures, for both verbal language and manual signing, correlated highly with similar measures from a conversation sample. The developed narrative task proved useful and valid to evaluate the language and communication skills of adults with ID taking into account both their verbal language and manual sign use.

5.1. Introduction

Narrative skills can be defined as those skills needed to tell stories, or to recount "unique past adventures that preserve the chronology of the component events discussed" (Peterson, 1990, p. 434). Because narratives call on semantic, morphosyntactic, and pragmatic language and communication skills (besides other cognitive skills such as working memory and general knowledge base), narrative tasks have proven to be a valid method to collect a variety of information concerning language abilities (Wellman et al., 2011). Narrative tasks have some advantages over standard language tests, by which we mean language tests that evaluate semantic, morphosyntactic, and pragmatic skills separately (for example the Peabody Picture Vocabulary Test for receptive semantic skills, Dunn & Dunn, 2005). In a relatively short period of time, and in a naturalistic setting, narratives address these different aspects of both language content and form in one task (Pankratz, Plante, Vance, & Insalaco, 2007; Paul & Smith, 1993). Narratives are quite a comprehensive measure of spoken language, because multiple language aspects need to be integrated by the participant to form a cohesive, well-formulated, meaningful story (Seiger-Gardner, 2009). Narrative tasks are used frequently for diagnostic and predictive reasons in children and adults with a suspected communication impairment (e.g., Doyle et al., 2000; Pankratz et al., 2007; Paul & Smith, 1993). For adults with intellectual disability (ID) as well, narrative tasks have been used successfully to map language and communication skills (see 5.1.3). Many adults with ID however, because of their communication problems, make use of augmentative and alternative communication (AAC; Uliano et al., 2010). To our knowledge, no narrative task directed at adults with ID who use AAC exists. This study focuses on the development and evaluation of a narrative task designed specifically for adults with ID who use key word signing (KWS) as their means of AAC. In this introduction, we first give an overview of different types of narrative tasks (5.1.1) and of story grammar (5.1.2). Next, a literature review of studies addressing the use of narrative tasks in adolescents and adults with ID is included (5.1.3). Key word signing and the possible advantages of a narrative task for individuals who use KWS are described hereafter (5.1.4). Finally, we define the aims of this study (5.1.5).

5.1.1. Types of narrative Tasks

Different types of narrative tasks exist, for example story telling (narrating a known story), story retelling (reproducing a story that was presented), and story generating (making up a story, possibly with the help of a given story stem). Stories can be personal or fictional (van Bysterveldt, Westerveld, Gillon, & Foster-Cohen, 2012). Also, stories can be presented orally, visually, or both orally and visually, using for example pictures, photographs, or film (for a review, see Liles, 1993). The type of narrative task has been found to influence the narratives produced by the participant. Schneider (1996) found that story retelling of a solely orally presented story made children provide more story information than generating a story from pictures. The author attributed this to the fact that orally presented stories provide prior linguistic structuring, whereas generating a story from pictures without an oral example requires putting an event into words. On the other hand, retelling an orally presented story without the support of pictures, relies more on short term memory skills. Liles (1993) concluded in her review that visual input did seem to facilitate faithful reiteration of the original narrative. When stories are presented both orally and visually, less memory load is required and a linguistic structure is offered, but participants may provide less information to the listener because they may treat the visual information as given (certainly when the listener can see the pictures, which are then shared information). Participants (certainly young children) may also become distracted by the pictures (Schneider, 1996). In studies by Merritt and Liles (1989) and by Westerveld and Gillon (2010), both typically developing children and children with language and reading disorders produced longer and more complete narratives (more story grammar components and more complete episode structures; see 5.1.2) during story retelling compared with during story generating (both with and without picture support). Finally, story retelling narratives take less time to transcribe and can be more reliably scored, because the story model provides the examiner with known story content (Merritt & Liles, 1989).

5.1.2. Story grammar

The production of narratives is thought to be guided by a cognitive organization, which is called a story schema. This global organization of content is often referred to as the macrostructure of narratives, in contrast with the microstructure which comprises measures such as number of utterances, number of words, mean length of utterance (MLU), and type token ratio (TTR; Liles, Duffy, Merritt, & Purcell, 1995). MLU and TTR are both measures of language proficiency. MLU is calculated by dividing the number of morphemes or words that are produced in a language sample by the number of utterances, and offers an estimate of syntactic ability. In this study, we used the number of words to calculate MLUs. The equivalent term for sign utterances is called mean length of sign turn (MLST, Grove & Dockrell, 2000). TTR is calculated by dividing the number of different words used in a sample by the total number of words, and is related to semantic skills, although the number of different words per se can also be a good index of lexical diversity (Watkins, Kelly, Harbers, & Holly, 1995). An example of the calculated micro- and macrostructural measures of the narrative task used in this study, can be found in Appendix E. A commonly used set of story grammar rules is that developed by Stein and Glenn (1979, in Liles, 1993; Merritt & Liles, 1987, 1989). They stated that narratives consist of one or more episode structures, each episode structure containing minimum an initiating event or internal response, an attempt, and a direct consequence. In other words: a protagonist faces a problem (initiating event) and may devise a plan (internal response), attempts to solve the problem (attempt), and succeeds or fails in doing so (consequence). Optional components that may be added to these essential components are setting (time, location, context) and reactions (emotional responses to the events), yielding a total of six possible story grammar components. An example of story grammar components applied to the narrative task used in this study, can be found in Appendix F. Story grammar components are all related, usually temporally or causally, and are believed to be processed as units rather than as series of statements (Liles, 1993). Trabasso and Van den Broek reanalysed data by Omanson (1982, in Trabasso & Van den Broek, 1985) and Stein and Glenn (1979, in Trabasso & Van den Broek, 1985) of story retelling narratives by normally developing adults and children. They found the following order in which story grammar components are recalled, summarized, and judged important: settings, consequences, initiating events, internal responses, reactions, and finally attempts (with settings being recalled and summarized most easily and judged most important, and attempts being most difficult and judged least important). A more thorough description of the story grammar components can be found in Merritt and Liles (1987).

5.1.3. Narrative tasks in participants with ID

Most literature on the use of narrative tasks in participants with ID describes narratives of children and adolescents (e.g., Chapman, Seung, Schwartz, & Kay-Raining Bird, 1998; Estigarribia et al., 2011). Only limited studies include adults with ID. Narratives have been studied mostly in participants with Down syndrome (DS) or Fragile X syndrome (FXS).

Abbeduto, Benson, Short, and Dolish (1995) compared the language measures on a story generation task and a conversation language sample between children and adolescents with ID (diverse aetiologies), and mental age matched typically developing children. They found no significant differences between the two groups in terms of syntactic complexity and lexical diversity. The narrative task generated syntactically more complex utterances, whereas the conversation task generated more utterances per minute (see also 5.1.4).

The research group of Chapman et al. performed some studies on the narrative skills of children, adolescents, and young adults with DS. In a first study (Chapman et al., 1998), different conversational and narrative tasks were used in a group of participants with DS and a group of mental age matched typically developing children. Their language proficiency was evaluating through story telling of favourite stories, telling about recent events using photographs (personal narratives), and describing a complex event picture, the *Cookie Theft Card*. Narratives produced a richer language sample (longer utterances and more diverse word use) compared with conversation for both the DS group and the typically developing group. Compared with the mental age matched typically developing children, participants with DS produced significantly fewer and fewer different words, and shorter utterances, despite a higher rate of utterance attempts per minute, on both the conversational and the narrative tasks. They did however show vocabulary and syntax comprehension skills consistent with their mental age (Chapman et al., 1998). Van Bysterveldt et al. (2012) found similar results with regard to the personal narratives (elicited using photographs) of 25 children with DS: low MLUs and semantic diversities were found. When a story generating task (based on a wordless movie) was used, participants with DS produced equally complex stories compared with mental age matched children, but significantly longer and more complex narratives compared with children matched on expressive language skills (Boudreau & Chapman, 2000). The linguistic expression of the DS group in general however, was significantly poorer than that of the mental age matched children, and comparable to that of the group matched on expressive language skills. Similar results were found when a story generating task based on a wordless picture story (*Frog, Where Are You?*, Mayer, 1969) was used: participants with DS produced significantly more plot lines, thematic content, and misadventures compared with a group of children matched on expressive language skills, despite of their expressive lexical and syntactic difficulties (Miles & Chapman, 2002). The authors related this to their higher syntactic comprehension skills and experience with story content. Kay-Raining Bird, Cleave, White, Pike, and Helmkay (2008) used a story generating task based on a wordless picture story as well. The participants with DS produced longer, but not necessarily better narratives, compared with those of a control group matched for reading ability. No differences in linguistic complexity of the narratives were found, possibly due to too short narrative samples and due to matching for reading ability instead of mental age. Vocabulary comprehension was the strongest predictor for narrative abilities in participants with DS. Finally, a story retelling task with orally presented stories without visual support was used in a group of children and adolescents with DS (Kay-Raining Bird, Chapman, & Schwarz, 2004). The narratives of the group with DS contained fewer gist recall units, more implausible inferences, and more extraneous information compared with those of mental age matched controls. The authors presumed that processing these solely auditory presented narratives may demand too much of the cognitive skills (and verbal auditory memory skills in particular) of children and adolescents with DS. Iacono, Torr, and Wong (2010) also found that a story generating task based on wordless picture books and pictures from popular movies demanded too much from most adults with DS who participated in their study. Only 9 of 55 participants were able to provide detailed narratives, whereas most of them only provided picture descriptions or participated in a conversation with the examiner.

Besides participants with DS, Keller-Bell and Abbeduto (2007) also added participants with FXS to their experimental group. They compared the narrative skills of adolescents and young adults with DS and FXS with those of typically developing children. A story generating task based on a wordless picture story (*Frog Goes to Dinner*, Mayer, 1974) was used. The participants with DS generated more ungrammatical utterances but with more narrative evaluation devices (such as mental state verbs, character names, character dialogue, fantasy, and so on) compared with those with FXS. In a subsequent comparable study, the participants with DS and FXS outperformed the typically developing controls with regard to some macrostructural narrative elements, such as introduction (Finestack, Palmer, & Abbeduto, 2012). However, although all participants were verbally expressive (MLUs greater than 3.00), they did not fully master narrative language on a macrostructural level.

In summary, most evidence points out that children, adolescents, and adults with DS and FXS have most difficulties with morphosyntactic aspects of narratives (also called microstructure) on story telling and generation tasks, in contrast with the narrative content (also called macrostructure) which seems to be reproduced equally well or even better by DS individuals compared with mental age matched controls. On story retelling tasks however, individuals with DS produce fewer complete narratives. Also, in a group of individuals with ID with unknown aetiologies, no differences in microstructural narrative aspects were found compared with age matched controls.

5.1.4. Narrative skills of people who use KWS

In none of the aforementioned studies other forms of communication than verbal (spoken or written) language were considered. However, many people with ID and communication problems make use of AAC. AAC aims to support people who have problems with convenient communication forms (spoken language) with any means of communication available. These AAC means can be aided, when an external device is needed (for example pictograms or speech generating devices), or unaided, when no external device is necessary (Uliano et al., 2010). The type of AAC examined in this study, KWS, is an unaided form of AAC and involves the simultaneous use of spoken language and manual signs, with the key words in the spoken sentence supported by a sign (Beukelman & Mirenda, 2005). Those key words are the words that carry most meaning. Besides supporting key words with manual signs, other extralinguistic information (for example body signals, touch, and facial expression) can be added and contextual references (for example pointing and adding direction to signs) can be made (Loncke, Nijs, & Smet, 1998). Although professionals often use the terms *simultaneous communication*, *signing*, *manual signing*, or even *sign language* when describing the use of manual signs as AAC, the method most frequently used in people with ID is probably KWS (Beukelman & Mirenda, 2005). *Simultaneous communication* is a broader term than KWS, and can also refer to methods in which more than only the key words are supported by manual signs (Romski & Sevcik, 2003). *Signing* and *manual signing* are also broad terms and do not indicate that spoken language is combined with the signs. *Sign language*, finally, is a full-fledged language with its own lexical and grammatical rules (Hickok, Bellugi, & Klima, 2001).

KWS as a term considers the use of manual signs not only from the perspective of the person with a disability, but also from that of his or her environment. The person with a disability who uses KWS will sometimes not be able to produce (intelligible) spoken language, and might thus only produce manual signs. His or her communicative environment, however, should always combine spoken language and manual signs. This approach has been found to make their communication easier to understand (Windsor & Fristoe, 1989) and, by offering a multimodal input, more redundant (Loncke, Campbell, England, & Haley, 2006). Adults with ID who use KWS and do produce spoken language, have been found to be more intelligible when they use KWS (Powell & Clibbens, 1994). Millar, Light, and Schlosser (2006) reviewed the effect of different forms of AAC on speech production, and found that unaided AAC (KWS, among other forms) can stimulate speech production and will certainly not impede it. Schlosser and Sigafoos (2006) reviewed different single-subject experimental studies and found that KWS (referred to as simultaneous communication) was more effective in yielding expressive signing, and expressive and receptive speech, compared to a sign alone or oral instruction approach (although the methodologies of reviewed studies often lacked rigor). Reviews on the explanatory models of KWS can be found in Bryen and Joyce (1986) and Loncke et al. (1998). A survey study indicated that KWS is used frequently by adults with ID (in over 50% of residential or day care services in Flanders, and by over 25% of the users of these services, Meuris, Maes, & Zink, in press).

The narrative skills of people who use AAC, and KWS specifically, to our knowledge have not been addressed in literature. Chapman et al. (1998) and Boudreau and Chapman (2000) for example, excluded participants who used manual signs as their primary means of communication from their study. Still, the use of narrative tasks in adults with ID who use KWS (and AAC in general) could provide a number of advantages. First, as mentioned above, the relatively short period of time needed to perform a narrative task is an obvious advantage over the use of longer, more elaborate language tests. Certainly in a population that may have difficulties with motivation and attention span, a narrative task can drastically shorten the time needed for language evaluation. Second, because KWS can be included in the presentation of the task, it more closely resembles a natural communicative situation for KWS users. Third, a narrative task is quite familiar to most people with ID, and ties in more with the everyday use of language than language tests who focus on isolated words or sentences out of context (Merritt & Liles, 1989). Fourth, compared with conversational language, Abbeduto et al. (1995) found that narratives elicited more syntactically complex language (higher MLU, as was also found by Chapman et al., 1998), whereas participants were more talkative in the conversations (larger number of utterances per minute). A higher TTR was found as well in conversations compared with narratives for children with and without language impairments (Leadholm, Miller, Contrucci, Brittingham, & Odell, 1992, in Abbeduto et al., 1995), whereas Chapman et al. (1998) found a more diverse word use in narrative tasks compared with conversations. Fifth, narrative tasks have some advantages over conversational language analyses, such as a stable context (in contrast to the variable context of conversations, for example in terms of topics discussed) and a less time-consuming procedure. Finally, most standard language tests do not take into account the use of AAC in general and KWS in particular. Clinically, we noticed that some people who obtained low scores on standard language tests, did however manage to express themselves on a higher level than expected with the aid of AAC. Diagnostic testing of communication in this population would benefit from procedures that take into account AAC, and we believe that, besides conversational language analysis, narrative tasks could serve this cause. Possibly, a narrative task could also give a better indication of the functionality of KWS than standard language tests would do. By functionality we mean the use of language with a communicative function or purpose, such as regulation or social interaction. Narratives involve a much richer possible use of communicative functions compared with vocabulary or morphosyntactic tests, in which communicative functions are often limited to naming. In conclusion, narratives seem a suitable addition to language evaluation procedures in the population of people with ID who use KWS.

5.1.5. Study aims

We developed a narrative task for adults with ID who use KWS. The aim of this narrative task is to gather information concerning language content and form of both spoken and signed language, in a relatively short amount of time, and in an enjoyable task which leans more towards natural communication settings than standard language tests, but which has an increased standardization and a decreased time investment than conversation language analyses. The task is evaluated in a group of 40 adult KWS users with ID. The purpose of this narrative task is twofold. The first goal is to map the language and communication skills of adult KWS users with ID, taking into account their use of manual signs besides their oral language skills. We hypothesize that the narrative measures concerning verbal language will correlate strongly with measures on standard language tests, but that the narrative measures concerning manual signing will not, because manual signing skills are rarely addressed in standard language tests. The second goal is to give an indication of the functionality of the KWS use of adult KWS users in everyday situations. We hypothesize that the overall narrative measures for verbal language and manual signs will correlate with similar measures from a conversation language sample. However, we do expect differences on separate microstructural measures such as MLU and TTR, because these have been reported in literature.

5.2. Methods

A narrative task was developed and administered in a group of 40 adult KWS users. Besides the narrative task, the adult KWS users participated in a language test battery and a conversation. Language form and content measures on the narrative task were correlated with the language test battery scores and with similar measures on the conversation language sample. This study was approved by the KU Leuven Medical Ethical Committee.

5.2.1. Participants

A group of 40 adults with ID, who used KWS as a means of AAC, participated in this study. This group was recruited among a group of adult KWS users who participated in a previous survey study (Meuris et al., in press). Inclusion criteria were: being an adult (> 18 years of age) with a congenital ID, and using KWS actively (minimum KWS use of 12 months, minimum expressive vocabulary of 10 signs, as reported by support staff). Exclusion criteria were: having an uncorrected visual or auditory impairment, having an ID caused by a traumatic brain injury, and having dementia. An informed consent was provided by the adults with ID, their parents or guardians, and their support staff.

All 40 adults made use of a residential (n = 24) or day care (n = 16) service in Flanders, the northern Dutch-speaking part of Belgium with over 6 million inhabitants. There were 19 male and 21 female participants, with a mean age of 38.71 years (SD = 9.65, age range: 25–64 years). Their mean mental age, retrieved from their personal file and based on the most recent IQ test available, was 57.57 months (SD = 15.60, range: 24–84 months). Some participants had additional disabilities: a disability of the upper limbs (spasticity, tremor, unilateral paresis or paralysis) was present in four participants and five other participants were diagnosed with a behavioural disorder. The aetiology of ID was Down syndrome in 52.50% (n = 21) of our participants. The aetiology was unknown for the remaining 19 participants. KWS was introduced before the age of 18 (at school) in 12 participants, and after the age of 18 (in the residential or day care service) in 25 participants. Time of introduction was unknown for three participants. All residential and day care services had a minimum of one staff member who had participated in the Flemish KWS training, and who was responsible for KWS in the service. The great variety in our participating population reflects the fact that, clinically, KWS is being used by a large variety of people (Meuris et al., in press). Our group of participants thus seems a representative sample of the population of adults with ID who use KWS in Flanders.

5.2.2. Procedure

First, a narrative task was developed. No task directed at the population of adults with ID who use AAC exists, and no existing task was found applicable to this population. Because the target population of this study is Flemish and thus speaks Dutch, we examined the existing Dutch narrative tasks. An overview of these tasks is given by Manders (2013). The instruments described in this paper appeared inefficient for use in adults with ID: stories were not adapted to their social world (directed at children) or grammatically too complex, stories relied too much on memory skills, the pictures were too small, unclear, too few or with too many small details, or the stories themselves were too intricate. Also, as pointed out by Schneider, Dubé, and Hayward (2009), many of the existing narrative tasks have not been devised according to any theoretical model of storytelling such as the story grammar rules. Furthermore, some frequently used tasks, such as the Bus Story Test (Renfrew, 1997), do not have a clear plot (Estigarribia et al., 2011).

We decided to develop a story retelling task with picture support, because this type of narrative task has a number of advantages. A story retelling task was chosen over a story generating task because both have proven to be effective measures of narrative skills in literature, with story retelling tasks generally being more clinically useful (providing longer stories with more story grammar components, requiring less transcription time, and providing more reliable scores; Merritt & Liles, 1989). We also opted for picture support, because this has been found to facilitate encoding and recall, and to reduce processing difficulties in children and adolescents with ID (Estigarribia et al., 2011; Liles et al., 1995; Miles, Chapman, & Sindberg, 2006). Children with DS are known to have more difficulties with auditory short term memory skills than with visual short term memory skills, compared with age and IQ matched children with ID from other aetiologies (Bower & Hayes, 1994). Adults with DS have been found to have deficits in auditory short term memory as well (Iacono, et al., 2010). Because half of our participants had DS, this was an indication against the use of a solely orally presented story, which would have disadvantaged the DS group. Also, as suggested by Abbeduto et al. (1995) and Estigarribia et al. (2011), picture support seems necessary to elicit enough narratives from this population, given their mental age and comorbid disorders.

The story to be retold was adapted from an existing Dutch children story of Max Velthuijs, *Een taart voor kleine beer* (A cake for little bear; Velthuijs, 1995). This story was chosen based on the authors' experience with the population of adults with ID and in consultation with two psychologists and five speech-language pathologists (SLP) working in the field. The story is simple and focuses on an everyday activity of baking a cake. The setting is a birthday, which is thought to be an appealing event to many adults with ID. Finally, the pictures of the storybook were judged to be clear and visually attractive.

The story was analysed using the story grammar scheme of Stein and Glenn (1979, in Merritt & Liles, 1987). The grammar of the story was described by means of the six possible story components: (a) settings, (b) initiating events, (c) internal responses, (d) attempts, (e) direct consequences, and (f) reactions. Based on a pilot test with two adults with ID who used KWS (one female, age: 29 years, mental age: 36 months; and one male, age: 52 years, mental age: 66 months), the story was adapted for the story retelling task purpose. The vocabulary of the story was simplified to contain only words that, according to the *Streeflijst Woordenschat 6-jarigen* (Target vocabulary list 6-year-olds; Schaerlaekens, Kohnstamm, & Lejaegere, 1999), should be understood by more than 90% of 6-year-old children (based on an extensive survey of preschool teachers). All key words of the story were supported by a manual sign (of the Flemish KWS system, Loncke et al., 1998). The final story consists of 35 utterances accompanied by 10 pictures and can be found in Appendix F. The story is mainly told in the present simple tense, with one utterance in the future simple tense and three in the past simple tense. With each picture, a mean of 3.50 utterances are given. The MLU of the story is 6.43 and the MLST is 2.09. A total of 225 words are used, with the number of different words being 93 (resulting in a TTR of .41). For manual signs, 34 different signs are used on a total of 73 signs (resulting in a TTR of .47). We identified 24 story grammar components in three episode structures. Each of the six possible story grammar components is present three to five times in the story (see Appendix F for the complete story).

The administration of the narrative task was introduced by telling the participant: "We will now look at a story. I will first tell the story to you, and afterwards, you may tell it to me." The story was told to the participant by an SLP who had practiced the story intensively and learned the story by heart. The exact same wordings and signs were used in each administration. The ten pictures were shown, one by one, while the story was being told with support of manual signs. Story presentation had a duration of about two and a half minutes. The participant was then asked to retell the story, with the pictures being shown again. The SLP minimized interventions during retelling, and responded only with neutral responses ("Yes," "oh," "uh-huh," and so on). If the participant needed motivation, the SLP said "Now you tell the story." If this did not prompt the participant to produce narratives, the SLP added "What do you remember?" and "Do you remember what happened?" The SLP asked: "Is that the end?" if the participant stopped talking or using manual signs without him/herself stating that the story was finished. A new picture was shown on the initiative of the participant, or if the participant was silent, even after motivation, for longer than 10 seconds. No length constraint was determined, and narratives ranged from 1 *min* 30 *s* to 4 *min* 25 *s* (M = 2 *min* 35 *s*). At no point did the SLP ask the participant to use manual signs. The narrative task was recorded with two video cameras (one directed at the SLP, one at the participant). These video clips were analysed, transcribing both the spoken language and manual signs produced by the participant.

A transcription procedure similar to that prescribed in the Bus Story Test (Renfrew, 1997) was used. Verbal language was transcribed literally and divided into distinctive utterances as described in the Bus Story Test manual (Renfrew, 1997). When a coordinating conjunction (for example "and" or "and then") was used, a new utterance was started, unless there was a coreferential participant deletion in the second clause. These conjunctions were excluded from analysis. Interactions with the test administrator, comments on events outside of the story, interjections, and repetitions were excluded from analysis. Spoken language that the transcriber could not understand after listening three times, was coded as unintelligible and was excluded from analysis. Sentence starts with "and," confirmations ("yes"), and denials ("no") were excluded from analysis as well. Manual signs were included when a minimum of two of three sign characteristics (hand shape, location, and movement) were correct (as described in the phonological analysis of the Flemish KWS system, Meuris, Maes, De Meyer, & Zink, 2014). The manual signs were registered in connection with the verbal key word if produced simultaneously, and separately as an utterance if produced without verbal language. Manual sign utterances without verbal language were divided into distinctive utterances when a pause of 5 or more seconds was present between signs. The outcome measures that were calculated for the story retelling task, are summarized in Table 5.1. Three types of outcome measures were included: measures of content (macrostructure), measures of length, and measures of semantic diversity (microstructure), based on those measures mentioned most in literature (Abbeduto et al., 1995; Boudreau & Chapman, 2000; Chapman et al., 1998; Doyle et al., 2000; Kay-Raining Bird et al., 2008; Miles & Chapman, 2002; Pankratz et al., 2007; Paul & Smith, 1993; Schneider, 1996). No measures of other microstructural aspects such as grammatical structures or discourse were included because this was not the focus of our study. The measures of content were based on the 24 story grammar components of the story. A verbal and a manual signing score were assigned. For verbal language, a 4-point scoring system was developed, with a score of 0 if the component was not mentioned, a score of 1 if only separate aspects of the component were mentioned, a score of 2 for a relation between two or more aspects but no completeness, and a score of 3 for a complete expression of the component. When scoring for example the first story grammar component, which is a setting ("In the morning, pig sits in her chair. She drinks coffee," see Appendix F), no or an irrelevant utterance would be given a score 0, mentioning only "pig" a score 1, combining "pig" and "coffee" a score 2, and expressing "in the morning, pig drinks coffee in her chair" a score 3. For manual signs, a score of 0 was assigned if no manual sign was used to express the component, and a score of 1 if one or more manual signs were used. The scoring options for each component were described in detail in a manual that can be obtained via email from the authors. As can be seen in Appendix F, some components are present three times in the story (for example internal responses), some four (for example initiating events), and some five (for example settings). To obtain a comparable score for each type of component, the scores were recalculated to a score from 0 to 12 for all types of components for the verbal scores, and a score from 0 to 4 for the manual signing scores. The total story grammar score was calculated by adding these scores for the six types of components, resulting in a total verbal score between 0 and 72, and a total manual signing score between 0 and 24. The measures of length and semantic diversity that were calculated can be found in Table 5.1. From these measures, the MLU and MLST were derived by dividing the total number of words or signs by the total number of utterances. The TTR was calculated as well, by dividing the number of different words or signs by the total number of words or signs. An example of a narrative sample and the calculated micro- and macrostructural measures can be found in Appendix E.

Transcription and scoring was done by three SLPs who had received a KWS training and a transcription and scoring training, using the manual that was composed for scoring the narrative task. A point to point inter-rater reliability (total number of agreements divided by total number of agreements and disagreements multiplied by 100) of 98.61% was obtained for transcription, and 89.80% for scoring (calculated on 15% of the data).

Besides the narrative task, a test battery of standard language and communication tests was administered. The first included test was the *ComFor* (Verpoorten, Noens, & van Berckelaer-Onnes, 2004), a clinical instrument for forerunners of communication. The ComFor consists of five series of items and measures perception and sensemaking at the levels of presentation (series 1, 2, and 3) and representation (series 4 and 5). It has very good psychometric properties (high internal consistency with a Cronbach’s alpha of .95 for presentation and .95 for representation, inter-rater reliability of .95 and test-retest reliability of .98; Noens, Van Berckelaer-Onnes, Verpoorten, & Van Duijn, 2006). Because the ComFor is an action-oriented test that does not produce a total score, principal component analysis (PCA) was used to generate an outcome score. PCA is a kind of factor analysis in which as much variability of the input variables as possible is explained by as few components as possible. The first principal component of the PCA from the scores of the five series of the ComFor was used as the outcome measure for this test.

Table 5.1. Outcome measures for narrative task (*N* = 40).

	Measure	**Code**	**Results**		
			M	***SD***	**range**
	Measures of content				
V	Story grammar score total (0 – 72)	VSGS	13.91	7.59	0.00 – 33.93
	SGS settings (0 – 12)		4.44	2.25	0.00 – 8.00
	SGS initiating events (0 – 12)		1.73	2.46	0.00 – 9.00
	SGS internal responses (0 – 12)		0.80	1.31	0.00 – 5.33
	SGS attempts (0 – 12)		3.56	2.16	0.00 – 8.00
	SGS direct consequences (0 – 12)		2.33	1.90	0.00 – 9.33
	SGS reactions (0 – 12)		1.05	1.66	0.00 – 7.00
M	Story grammar score total (0 – 24)	MSGS	5.29	2.93	0.00 – 9.53
	SGS settings (0 – 4)		2.04	1.29	0.00 – 4.00
	SGS initiating events (0 – 4)		0.28	0.45	0.00 – 1.00
	SGS internal responses (0 – 4)		0.30	0.56	0.00 – 1.33
	SGS attempts (0 – 4)		1.54	0.95	0.00 – 3.20
	SGS direct consequences (0 – 4)		0.83	0.72	0.00 – 2.67
	SGS reactions (0 – 4)		0.30	0.46	0.00 – 1.00
	Measures of length				
T	Number of utterances	TUTT	23.58	10.32	6 – 47
S	Number of simultaneous utterances	SUTT	10.13	8.39	0 – 36
V-M	Number of verbal utterances without support of manual signs	V-MUTT	11.45	10.50	0 – 46
M-V	Number of manual sign utterances without verbal language	M-VUTT	2.00	4.48	0 – 20
V	Number of verbal utterances (with or without support of manual signs)	VUTT	21.57	11.10	0 – 47
	Number of words	VWORD	51.20	34.36	0 – 139
M	Number of manual sign utterances (with or without verbal language)	MUTT	13.10	8.95	0 – 38
	Number of signs	MSIGN	15.20	10.57	0 – 43
	Measures of semantic diversity				
V	Number of different words	VDIFF	25.98	16.58	0 – 70
M	Number of different manual signs	MDIFF	8.55	5.67	0 – 24
	First principal component				
V	First principal component, based on VSGS, VUTT, VWORD, and VDIFF	VC	0.00	1.00	-1.93 – 2.09
M	First principal component, based on MSGS, MUTT, MWORD, and MDIFF	MC	0.00	1.00	-1.66 – 2.59

Note. V = verbal language, M = manual signs, T = total (verbal language with support of manual signs, verbal language without support of manual signs, manual signs without verbal language), S = simultaneous (verbal language with support of manual sign), V-M = verbal language without manual signs, M-V = manual signs without verbal language.

Second, the Dutch version of the *Peabody Picture Vocabulary Test* (PPVT III-NL, Dunn & Dunn, 2005) was included to measure receptive vocabulary skills. This test possesses a high internal consistency (lambda-2-coëfficient of .89 to .97, depending on the age group) and an excellent test-retest reliability (.94) as well (Dunn & Dunn, 2005; because this is a receptive vocabulary test, inter-rater reliability is not relevant). Finally, a comprehensive language test, the *CommunicatieProfiel-Z* (CPZ, Willems & Verpoorten, 1996) was included. This is the only available standardized Dutch language and communication test that was developed specifically for adolescents and adults with ID. It consists of four subtests: reception of nonverbal communication, reception of verbal communication, production of nonverbal communication, and production of verbal communication, resulting in one total score between 0 and 95. The internal consistency of the CPZ is satisfactory (Cronbach's alpha of .83 to .90 depending on the subtest), and the inter-rater reliability (.92) and test-retest reliability (.91 to .97, depending on the time interval between tests) are excellent as well (Willems & Verpoorten, 1996). For all tests, raw scores were used for further analysis.

Finally, to collect a language sample of functional communication, we collected a conversation language sample. An SLP engaged in a conversation with each adult with ID during 15 minutes. The SLP was an experienced KWS user and supported all key words in her utterances by manual signs. Play material was used to elicit a conversation: a Playmobil ® house, animals, furniture, and figurines. We applied a procedure similar to that described by Abbeduto et al. (1995), in that mainly open questions were asked and yes/no questions were avoided, and the interests and initiatives of the adult with ID were followed. The conversation was videotaped with two video cameras, and the language sample was transcribed, using the same procedure as that used for the narrative task. In addition, any direct repetitions and imitations of the SLP by the adult with ID were excluded from analysis. Also, every turn change initiated a new utterance. Three SLPs were trained to transcribe and score the language samples. Point by point inter-rater reliability was excellent (97.64% for transcription and 86.91% for scoring, calculated on 10% of the data). The same three types of outcome measures as for the narrative task were calculated for the language sample: measures of content, length, and semantic diversity (see Table 5.2).

Table 5.2. Outcome measures for conversation language sample (N = 40).

	Measure	Code	Results *M*	*SD*	range
	Measures of content				
V	Number of different communicative functions	VCF	6.03	2.11	2 – 10
M	Number of different communicative functions	MCF	3.26	1.60	1 – 7
	Measures of length				
T	Number of utterances	TUTT	55.14	26.72	11 – 112
S	Number of simultaneous utterances	SUTT	15.63	10.31	0 – 36
V-M	Number of verbal utterances without support of manual signs	V-MUTT	38.57	25.80	0 – 91
M-V	Number of manual sign utterances without verbal language	M-VUTT	0.94	2.01	0 – 8
V	Number of verbal utterances (with or without support of manual signs)	VUTT	54.20	27.16	9 – 112
	Number of words	VWORD	177.66	206.24	23 – 888
M	Number of manual sign utterances (with or without verbal language)	MUTT	16.57	10.18	1 – 36
	Number of signs	MSIGN	17.94	11.57	1 – 42
	Measures of semantic diversity				
V	Number of different words	VDIFF	77.06	57.01	11 – 263
M	Number of different manual signs	MDIFF	15.71	9.70	1 – 35
	First principal component				
V	First principal component, based on VCF, VUTT, VWORD, and VDIFF	VC	0.00	1.00	-1.46 – 2.65
M	First principal component, based on MCF, MUTT, MWORD, and MDIFF	MC	0.00	1.00	-1.59 – 2.15

Note. V = verbal language, M = manual signs, T = total (verbal language with support of manual signs, verbal language without support of manual signs, manual signs without verbal language), S = simultaneous (verbal language with support of manual sign), V-M = verbal language without manual signs, M-V = manual signs without verbal language.

To give an indication of the language content skills of the participants, all utterances were allotted a communicative function. According to Reichle (1997, p. 112), “a communicative function describes why an individual produced a particular utterance.” We used a communicative function division based on that of Wells (1985, in Kingma-van den Hoogen, 2010), with the main categories being *representation*, *control*, *expression*, and *interaction*. The operationalization of the different communicative functions was based on *The Pragmatics Profile of Everyday Communication Skills in Children* (Dewart & Summers, 1995) and *Adults* (Dewart & Summers, 1996). A category *answer* was added to the four categories of Wells, based on the literature review on communicative functions in adults with severe disabilities by Reichle (1997). The final division of the 16 communicative functions used to analyse the conversation language sample can be found in Table 5.3. For length and semantic diversity, the same measures of content as in the narrative task were used, as displayed in Table 5.2.

Table 5.3. Communicative functions (*N* = 40).

Main category	**Function**	**Results**					
		Verbal language			**Manual signs**		
		M	***SD***	**range**	***M***	***SD***	**range**
Representation	Giving information	33.46	21.41	4 – 87	12.37	8.71	0 – 31
	Naming	5.03	4.65	0 – 18	1.51	1.90	0 – 8
	Giving explanation	0.80	1.45	0 – 7	0.26	0.56	0 – 2
Control	Requesting for object, action, assistance, recurrence or information	1.83	3.23	0 – 15	0.31	1.08	0 – 6
	Giving instruction	1.03	1.99	0 – 9	0.23	0.43	0 – 1
	Giving suggestion	0.46	1.52	0 – 8	0.29	1.23	0 – 7
	Changing subject	0.40	0.74	0 – 3	0.26	0.74	0 – 4
	Correcting	0.60	1.12	0 – 4	0.26	0.56	0 – 2
Expression	Expressing emotion	0.03	0.17	0 – 1	/		
	Commenting on action, object, event, person	7.86	8.63	0 – 34	0.71	1.20	0 – 6
Interaction	Directing attention to self, object, event or other people	1.09	2.90	0 – 16	0.03	0.17	0 – 1
	Greeting on arrival or departure	0.40	1.17	0 – 6	0.11	0.40	0 – 2
Answer	Rejecting	/			/		
	Choosing	0.26	0.44	0 – 1	0.14	0.36	0 – 1
	Recapitulating	0.43	1.12	0 – 6	0.09	0.37	0 – 2
Other	Vocalizing	0.54	1.04	0 – 5	/		

All tasks and tests (the narrative task, language and communication tests, and the conversation) were conducted at the residence or day care centre of the participant. The SLP and the participant were seated at a table in a quiet room. For the language and communication tests, they were seated opposite to each other. For the narrative task and the conversation, the SLP was seated at 90° from the adult with ID. The total procedure took 2 to maximum 3 hours and was spread over three sessions, with each session lasting no longer than 1 hour and with a minimum of 24 and a maximum of 72 hours between sessions. The tasks and tests were administered in the same order for each participant. In a first session, the ComFor was administered. A second session covered the CPZ and the PPVT III-NL. In a final session, the narrative task and the conversation were undertaken.

5.2.3. Data analysis

Normality of the variables was tested with the Shapiro-Wilk test. PCA was used to derive the first principal component for the ComFor, and to reduce the language measures from the narrative task and the conversation language sample to a verbal language and a manual signing component for each task. For correlations, Pearson's *r* (for normally distributed variables) or Spearman's rho r_S (for nonnormally distributed variables) were used. Results were considered statistically significant at $p < .05$. Bonferroni corrections were applied for multiple comparisons. Analyses were performed with SPSS version 19.0.

5.3. Results

5.3.1. Language and communication tests

The results on the language and communication tests of the 40 participants of this study (scores on the ComFor, the PPVT III-NL, and the CPZ) can be found in Table 5.4. For the ComFor, scores on the five series of the test were reduced into one score by PCA. Because no participant made any mistakes in the first series (*presentation 1*), this series was excluded from analysis. The sampling adequacy was sufficient for the analysis (Kaiser-Meyer-Olkin measure of .76), and Bartlett's test of sphericity, χ^2 (6) = 67.58, $p < .001$, indicated that correlations between items were sufficiently large for PCA (Field, 2009). The first principal component has an eigenvalue of 2.60 and explains 64.88% of the total variance. Factor loadings on this component for the four included series of the ComFor (*presentation 2* and *3* and *representation 4* and *5*) are .90, .90, .88, and .45. The factor scores for this component were retained as the outcome measure for the ComFor.

Correlations between variables are displayed in Table 5.5. As expected, the results for the language and communication tests are significantly and moderately to highly correlated with each other and with the mental age of the participants, but not with their chronological age.

Table 5.4. Communication and language test results (N = 40).

Code	**Test**	**Results**		
		M	***SD***	**range**
COMFOR	ComFor (principal component)	0.00	1.00	–3.23 - 1.59
PPVT III-NL	Peabody Picture Vocabulary Test (raw scores)	53.40	21.40	8 - 88
CPZ	CommunicatieProfiel-Z (raw scores; score between 0 and 95)	75.83	14.73	35 - 95

Table 5.5. Correlation matrix between language and communication tests, mental age, chronological age, and measures of narrative task and conversation language sample (N = 40).

	PPVT	CPZ	MA	CA	N: VC	N: MC	C: VC	C: MC
COM-FOR	r_s = .74* p < .001	r_s = .68* p < .001	r_s = .64* p < .001	r_s = -.07 p = .659	r_s = .50* p = .001	r_s = .10 p = .556	r_s = .21 p = .225	r_s = .19 p = .286
PPVT		r_s = .82* p < .001	r = .45* p = .003	r_s = .09 p = .614	r_s = .57* p < .001	r_s = -.01 p = .956	r_s = .48* p = .003	r = .10 p = .582
CPZ			r_s = .50* p = .001	r_s = .13 p = 451	r_s = .70* p < .001	r_s = -.08 p = .631	r_s = .56* p = .001	r_s = .15 p = .405
MA				r_s = -.08 p = .635	r = .44* p = .004	r = -.02 p = .920	r_s = .19 p = .278	r = .12 p = .481
CA					r_s = -.03 p = .863	r_s = .04 p = .797	r_s = .20 p = .274	r_s = -.06 p = .762
N: VC						r = .09 p = .576	r_s = .61* p < .001	r = .08 p = .665
N: MC							r_s = .00 p = .991	r = .57* p < .001
C: VC								r_s = .24 p = .170

Note. COMFOR = principal component ComFor, PPVT = Peabody Picture Vocabulary Test III-NL, CPZ = CommunicatieProfiel-Z, MA = mental age, CA = chronological age, N = narrative task, C = conversation language sample, VC = verbal principal component, MC = manual signing principal component
* p < .05

5.3.2. Narrative task

An overview of the results for the narrative task can be found in Table 5.1.

5.3.2.1. Measures of content

The narrative skills related to the content of the story were measured using the story grammar components. Each type of story grammar component was allotted a score (from 0 to 12 for verbal language and from 0 to 4 for manual signs) and a total score was calculated for both verbal language (score from 0 to 72, VSGS in Table 5.1) and manual signs (score from 0 to 24, MSGS in Table 5.1). As can be seen in Table 5.1, both in verbal language and using manual signs, the most expressed components were settings ($M_{\text{verbal language}} = 4.44$, $M_{\text{manual signs}} = 2.04$) and attempts ($M_{\text{verbal language}} = 3.56$, $M_{\text{manual signs}} = 1.54$). The least expressed components were internal responses for verbal language ($M_{\text{verbal language}} = 0.80$) and initiating events for manual signs ($M_{\text{manual signs}} = 0.28$). A Friedman's Anova showed that the differences in scores among the six different types of components are significant for both verbal language, $\chi^2(5) = 88.59$, $p < .001$, and manual signs, $\chi^2(5) = 107.55$, $p < .001$.

5.3.2.2. Measures of length

Table 5.1 displays the measures of length used to assess the narrative skills of the participants of this study. The mean total number of utterances was 23.58 (TUTT in Table 5.1), and the mean distribution of types of utterances were 48.56% of verbal language utterances without the support of manual signs (V-MUTT in Table 5.1, 11.45 out of 23.58), 42.96% of simultaneous utterances (verbal language supported with manual signs, SUTT in Table 5.1, 10.13 out of 23.58), and 8.48% of manual sign utterances without verbal language (M-VUTT in Table 5.1, 2.00 out of 23.58). The mean MLU is 2.37 (VWORD / VUTT, SD = 1.17, range: 1–5.36) and the mean MLST is 1.15 (MSIGN / MUTT, SD = 0.26, range: 1–2.43) and this is a significant difference (Wilcoxon signed-rank test $T = 1$, $p < .001$, $r = -.57$).

5.3.2.3. Measures of semantic diversity

The mean number of different words (VDIFF) and manual signs (MDIFF) can be found in Table 5.1. The mean TTR is .53 for verbal language (VDIFF / VWORD, SD = 0.08, range: .37–.82) and .65 for manual signs (MDIFF / MSIGN, SD = 0.22, range: .14–1) and this is a significant difference (Wilcoxon signed-rank test T = 115.50, p = .001, r = -.38).

5.3.3. Conversation language sample

An overview of the results for the conversation language sample, can be found in Table 5.2.

5.3.3.1. Measures of content

The number of different communicative functions used in verbal language (VCF in Table 5.2) and using manual signs (MCF in Table 5.2) were used as measures of content in the conversation language sample. To obtain this number, all utterances produced by the participants were allotted a communicative function. Table 5.3 gives an overview of the division of 16 possible communicative functions. For both verbal language and manual signs, most utterances had a representational function of giving information ($M_{\text{verbal language}}$ = 33.46 or 61.73% of the total of 54.20 [VUTT in Table 5.2]; $M_{\text{manual signs}}$ = 12.37 or 74.65% of the total of 16.57 [MUTT in Table 5.2]) and naming ($M_{\text{verbal language}}$ = 5.03 or 9.28%; $M_{\text{manual signs}}$ = 1.51 or 9.11%) or an expression function of commenting ($M_{\text{verbal language}}$ = 7.86 or 14.50%; $M_{\text{manual signs}}$ = 0.71 or 4.28%). The least occurring communicative functions for verbal language were rejecting (none), expressing emotion ($M_{\text{verbal language}}$ = 0.03 or 0.06%), choosing ($M_{\text{verbal language}}$ = 0.26 or 0.48%), greeting ($M_{\text{verbal language}}$ = 0.40 or 0.74%), and changing subject ($M_{\text{verbal language}}$ = 0.40 or 0.74%). For manual signs, the least occurring communicative functions were rejecting (none), expressing emotion (none), directing attention ($M_{\text{manual signs}}$ = 0.03 or 0.18%), recapitulating ($M_{\text{manual signs}}$ = 0.09 or 0.54%), greeting ($M_{\text{manual signs}}$ = 0.11 or 0.66%), and choosing ($M_{\text{manual signs}}$ = 0.14 or 0.84%). The differences in frequency of the 16 different communicative functions are found significant by a Friedman's Anova for both verbal language, $\chi^2(15)$ = 261.66, p < .001, and manual signs, $\chi^2(15)$ = 207.78, p < .001.

5.3.3.2. Measures of length

The measures of length derived from the conversation language sample can be found in Table 5.2. The mean total number of utterances was 55.14 (TUTT in Table 5.2). The types of utterances were distributed as follows: 69.95% of verbal language utterances without the support of manual signs (V-MUTT in Table 5.2, 38.57 out of 55.14), 28.35% of simultaneous utterances (verbal language supported with manual signs, SUTT in Table 5.2, 15.63 out of 55.14), and 1.70% of manual sign utterances without verbal language (M-VUTT in Table 5.2, 0.94 out of 55.14). A mean MLU of 2.76 for verbal language (VWORD / VUTT, SD = 1.86, range: 1–9.65) and 1.07 for manual signs (MSIGN / MUTT, SD = 0.10, range 1–1.40) is found, and this difference is significant (Wilcoxon signed-rank test $T = 1$, $p < .001$, $r = -.58$).

5.3.3.3. Measures of semantic diversity

In Table 5.2, the mean number of different words (VDIFF) and signs (MDIFF) can be found. Based on these measures, a mean TTR of .55 for verbal language (VDIFF / VWORD, SD = 0.16, range: .20–.90) and .90 for manual signs (MDIFF / MSIGN, SD = 0.11, range: .59–1.00) is found, and this is a significant difference (Wilcoxon signed-rank test $T = 1$, $p < .001$, $r = -.58$).

5.3.4. Principal component analysis

A PCA was used to reduce the measures on the narrative task and of the language sample during conversation into one verbal component (VC) and one manual sign component (MC) for each task. The content measures included in the analysis were the story grammar total score (for verbal language and for manual signs) for the narrative task, and number of different communicative functions used (for verbal language and for manual signs) for the conversation language sample. The measures of length included for both tasks were the number of utterances (for verbal language and for manual signs) and the number of words/signs produced. Finally, the included measures of semantic diversity were the number of different words and manual signs produced. For the narrative task, a Kaiser-Meyer-Olkin measure of .68 for the VC and .83 for the MC indicated a sufficient sampling adequacy. Bartlett's test of sphericity,χ^2

(6) = 166.90, $p < .001$ for VC, χ^2 (6) = 176.06, $p < .001$ for MC, indicated sufficiently large correlations between items (Field, 2009). For the conversation language sample as well, the Kaiser-Meyer-Olkin (.72 for the VC and .83 for the MC) and Bartlett's test of sphericity measures, χ^2 (6) = 135.41, $p < .001$ for VC, χ^2 (6) = 238.23, $p < .001$ for MC, were sufficient. The results of the PCA can be found in Table 5.6.The factor scores for the found components were retained as the outcome measure for the narrative task and for the conversation language sample.

Table 5.6. Summary of principal component analysis for measures on narrative task and conversation language sample ($N = 40$).

Narrative task			
Verbal component		***Manual sign component***	
Measure	Factor loadings	Measure	Factor loadings
Story grammar score	.75	Story grammar score	.86
Number of utterances	.80	Number of utterances	.95
Number of words	.96	Number of signs	.97
Number of different words	.96	Number of different signs	.94
Eigenvalue	3.03	Eigenvalue	3.48
% of variance	75.80	% of variance	86.90
Conversation language sample			
Verbal component		***Manual sign component***	
Measure	Factor loadings	Measure	Factor loadings
Number of different communicative functions	.81	Number of different communicative functions	.78
Number of utterances	.94	Number of utterances	.98
Number of words	.89	Number of signs	.98
Number of different words	.95	Number of different signs	.97
Eigenvalues	3.24	Eigenvalue	3.48
% of variance	81.09	% of variance	86.95

5.3.5. Correlations

Correlations between the language and communication tests, and the principal components (verbal and manual signs) of the narrative task and conversation language sample, were calculated and can be found in Table 5.5. The ComFor, PPVT, and CPZ test results all correlate significantly and strongly with the verbal components of both the narrative task (r_s = .50, .57, and .70) and the conversation language sample (r_s = .48 for PPVT and .56 for CPZ), except for the ComFor test results and the latter. The opposite is true for the manual sign components of both tasks: these do not correlate with the language and communication tests. The verbal component of the narrative task correlates significantly and strongly with that of the conversation language sample (r_s = .61), and the manual sign components of both tasks correlate significantly as well (r = .51).

To further explore this strong correlation between the principal components of the narrative task and the conversation language sample, correlations of the separate measures on these tasks were calculated and can be found in Table 5.7. The highest correlations are found between the number of words (r_s = .69) and the number of different words (r_s = .72) produced in both tasks. Correlations between the number of manual sign utterances (r = .49), the number of manual signs (r = .52), and the number of different manual signs (r = .59) are also significant and strong. The measures of content (story grammar scores and number of different communicative functions), do not correlate significantly, neither do the total number of utterances and the number of verbal and simultaneous utterances.

Table 5.7. Correlations between measures of content, length, and semantic complexity of narrative task and conversation language sample (N = 40).

	Measures of content	
Narrative task	***Conversation language sample***	***Correlation***
VSGS	VCF	$r = .27, p = .119$
MSGS	MCF	$r_s = .21, p = .221$
	Measures of length	
Narrative task	***Conversation language sample***	***Correlation***
TUTT	TUTT	$r = .19, p = .266$
VUTT	VUTT	$r = .26, p = .135$
MUTT	MUTT	$r = .49^*, p = .003$
SUTT	SUTT	$r_s = .32, p = .065$
VWORDS	VWORDS	$r_s = .69^*, p < .001$
MSIGNS	MSIGNS	$r = .52^*, p = .001$
	Measures of semantic diversity	
Narrative task	***Conversation language sample***	***Correlation***
VDIFF	VDIFF	$r_s = .72^*, p < .001$
MDIFF	MDIFF	$r = .59^*, p < .001$

Note. V = verbal language, M = manual signs, SGS = story grammar score, CF = number of different communicative functions, T = total (verbal language with support of manual signs, verbal language without support of manual signs, manual signs without verbal language), UTT = number of utterances, S = simultaneous (verbal language with support of manual sign), WORDS = number of words, SIGNS = number of signs, DIFF = number of different words/signs.
* $p < .05$

5.3.6. Microstructural measures of narrative task in comparison with conversation language sample

When comparing the microstructural measures of the narrative task and the conversation language sample statistically, few significant differences are found. The MLU for verbal language was slightly higher during the conversation (M = 2.76) compared with during the narrative task (M = 2.37), but this difference is not statistically significant (Wilcoxon signed-rank test T = 212, p = .144). On the other hand, the MLU for manual signs was slightly higher during the narrative task (M = 1.15) compared with during the conversation (M = 1.07), but again, this difference is statistically not significant (Wilcoxon signed-rank test T = 117.50, p = .226). The TTR for manual signs was significantly higher in the conversation (M = .90) than in the narrative task (M = .65) (Wilcoxon signed-rank test T = 7.00, p < .001, r = -.49), but the TTR for verbal language did not differ significantly between the narrative task (M = .53) and the conversation (M = .55) (Wilcoxon signed-rank test T = 246.00, p = .379).

5.4. Discussion

Narrative tasks appeal to a large variety of semantic, grammatical, and pragmatic skills, and have proven to be a convenient and time-saving way of mapping communicative skills in adults with ID. A narrative task offers good conditions to include other means of communication besides spoken language, for example KWS. Therefore, a story retelling task was developed for and administered in a group of 40 adults with ID who used KWS as their main means of AAC. The first aim of this study was to use the narrative task to evaluate the language and communication skills of adult KWS users, and to compare the results with those on standard language and communication tests. The second aim was to evaluate the functional use of KWS in the participating adults with ID, and to compare measures on the narrative task with those of a conversation language sample.

5.4.1. Characteristics of the narrative task

A narrative task was developed specifically for adults with ID who use KWS. This story retelling task covers a popular topic (celebrating birthday) and offers pictures to support the auditory memory of the participants. Of course, because we used a newly developed narrative task, it is not always evident to compare our findings with those reported in literature, in which different tasks have been used in different populations. Still, this is the first narrative task in which AAC, and more specifically KWS, is used. Also, because we describe the developed task in great detail, the replicability of this study is quite high. The inter-rater reliability of the task was also high. The narrative task produced a wealth of information concerning both verbal language and manual signing skills of our participants. With regard to the measures of content on the narrative task, the mean and maximum scores that were obtained are quite low ($M_{\text{verbal language}}$ = 13.91, with a maximum score of 33.93 out of 72; $M_{\text{manual signs}}$ = 5.29, with a maximum score of 9.53 out of 24). On one hand, this shows that no ceiling effect was present and that the task offered sufficient challenge for our target population. On the other hand, the task might have been (too) difficult for some of our participants. Similar to what Iacono et al. (2010) reported, some of our participants limited their narratives to descriptions of what could be seen on the pictures accompanying the story. Still, all participants did mention at least three different story grammar components, verbally, with support of signs, or combining both modalities. This indicates that no floor effect was present in our test group, and variation in the scores was high enough to detect differences in narrative skills. With regard to the order of difficulty for the story grammar components, a similar order was found for verbal language as for manual signs. For both expression forms, settings were expressed most, followed by attempts and direct consequences. The most difficult story grammar components were initiating events, reactions, and finally internal responses for verbal language, and reactions, internal responses, and initiating events for manual signs. These orders differ from that found by Trabasso and Van den Broek (1985) in typically developing children and adults. What stands out most, is that attempts were the most difficult component in the latter study, while being the second most expressed component in the present study. This can be attributed to the fact that the specific story that we used in this study focuses on the attempts of baking and eating a cake, the central theme of the story, and thus may be eliciting more attempt components compared with other stories.

5.4.2. Narrative task compared with standard language tests

To evaluate if the narrative task gives a good account of the oral language skills of the participants, we compared the outcome measures of the narrative task (the first principal component for both verbal language and manual signing) with scores on standardized language and communication tests. As hypothesised, the narrative verbal component correlates significantly with all three included tests. This shows that the narrative task was capable of detecting verbal communication problems in our population. Narrative tasks require the integration of different language components and thus demand a higher level of language skills compared with the standard language tests in which language components are tested separately and in isolated words/sentences. Still, with correlations from .53 up to .69, this narrative verbal component seems promising for indication of verbal language problems.

On the other hand, the manual signing component of the narrative task does not correlate with any language or communication test scores. This is a striking result. It shows that, even though we did include nonverbal (sub)tests in our test battery (ComFor and CPZ), they do not seem to detect the communicative abilities of a person who uses KWS to the fullest. The ComFor is a test that is completely nonverbal. Still, scores on the ComFor only seem to correlate with the verbal component of the narrative task. Also, in the CPZ, two nonverbal subtests are included. The total test score however also only correlates with the verbal component of the narrative task. These results show us that the language and communication tests currently available for adults with ID do not seem to take into account KWS supported communication. This stresses the need for other methods to measure their language skills, with the developed narrative task being a proposed alternative. The narrative task also shows a number of advantages over standard language tests, such as shorter time investment, more pleasant task for the participant, and a closer resemblance to natural communication, as described in 5.1.4.

5.4.3. Narrative task compared with conversation

To examine the ability of the narrative task to evaluate the functionality of the communication of adult KWS users with ID, we compared the principal components of the narrative task with those of the conversation language sample. Strong correlations for both verbal language (.61) and manual signs (.57) were found. This shows that a great amount of information that can be gathered trough conversation analysis, also is present in the narrative task. Because the narrative task has multiple advantages over the conversation, such as a shorter time investment and a better defined context, narrative tasks can certainly be a good first step in evaluating the functional conversation of KWS users.

When comparing the microstructural measures on the narrative task with the conversation language sample, some differences also stand out. With regard to the measures of length, the proportion of manual sign utterances (with or without verbal language) was much larger in the narrative task (51.44%, sum of SUTT and M-VUTT in Table 5.1) than during the conversation (30.05%, sum of SUTT and M-VUTT in Table 5.2). The narrative task thus seems more appropriate to elicit a larger corpus of manual signs. This can be related to the concreteness and high illustrativeness of the story, in contrast to the sometimes highly abstract topics addressed in the conversations (for example the emotional reaction on the passing of a family member, or difficulties accepting one's ID). Because the initiatives of the participants were followed, some participants started to tell about the events that occupied them emotionally at the time of the conversation, resulting in more abstract language use. The story in the narrative task was very concrete and resulted in a higher sign use. With regard to the MLU and MLST, no statistically significant differences were found between the narrative task and the conversation. This is in contrast to the findings of Abbeduto et al. (1995) and Chapman et al. (1998) who found a higher MLU during narrative tasks. We did try to develop a grammatically simple story attuned to the abilities of our target population, and possibly offered a story with a lower MLU than the stories used by Abbeduto et al. and Chapman et al. We did find a slightly higher MLST in the narrative task, which, although statistically not significant, might also point towards the narrative task being more suitable to elicit manual signs in a population of adults with ID in comparison with the conversation. On the contrary, the TTR for manual signs was significantly higher in the conversation than in the narrative task, so the conversation did evoke a larger semantic diversity with regard to manual signs. This seems logical, because the narrative task is quite short in both length and time, and has a clearly defined topic (baking a cake) with only 34 different signs presented, whereas the conversations lasted 15 minutes and followed the interests of the participants. The TTR for verbal language did not differ significantly between the narrative task and the conversation, so a similar diversity of words was evoked in both tasks.

5.5. Conclusion

This study describes a first attempt to develop a narrative task for adult KWS users. The developed narrative task proved useful and valid in this target population. Both verbal language and manual signing abilities could successfully be evaluated with the narrative task. This study indicates the usefulness and value of a narrative task in mapping the communicative strengths and weaknesses of an adult KWS user with an ID. This narrative task could be used clinically as a first indication of the communicative abilities of a KWS user, or as a more in-depth evaluation of the functionality of his or her communication. In this first study to explore the use of this newly developed narrative task, we evaluated the inter-rater reliability as very high. Because the test results correlate highly to standard language and communication tests (for verbal language) and to language measures of a conversation language sample, the narrative task shows a good convergent validity. The remaining psychometric properties of this task, such as test-retest and intra-rater reliability, remain to be evaluated in future studies. The application of this narrative task could be expandable to other forms of AAC, such as pictograms or speech generating devices. The narrative task could also be used to predict the ability of adults with ID to learn to use KWS for functional communication. This will be studied in a subsequent intervention study, in which KWS will be taught to a group of adults with ID, who will participate in the narrative task before and after the intervention.

In conclusion, the narrative task developed in this study gives a good indication of both the verbal language and manual signing skills of adult KWS users with an ID, and shows a number of advantages over the use of standard language tests or the analysis of a conversation language sample. Narrative tasks should be considered when evaluating the language and communication abilities of a KWS user.

Chapter 6
The relation between client and environmental characteristics and the functional key word signing use of adults with intellectual disability: intervention study

The content of this chapter has been described in:

Meuris, K., Maes, B., and Zink, I. (2014). Teaching adults with intellectual disability manual signs through their support staff: A key word signing program. Submitted to American Journal of Speech-Language Pathology.

Abstract

Purpose: The goal of this study was to evaluate a key word signing (KWS) program in which adults with mild to severe intellectual disability (ID) were taught manual signs through their support staff. Our hypotheses was that spontaneous manual sign production of support staff and their clients would increase significantly after 12 months of implementation of the KWS program.

Method: A KWS immersion program was implemented in a service for adults with ID. First, eight support workers received 8 hours of training. These KWS ambassadors then taught two manual signs per week to their colleagues, who modelled the use of the signs throughout the day in natural interactions with their clients. KWS use of 15 adults with ID and 15 of their support staff was evaluated before the start of the program and at a 12-month follow-up, using a narrative task and during spontaneous conversation.

Results: Manual sign production of support workers and clients had increased significantly 12 months after the start of the program. Clients were able to express significantly more communicative functions in their narrative language after the intervention, and when using KWS.

Conclusions: The KWS program was successful and can be applied in similar clinical settings.

6.1. Introduction

Adults with intellectual disabilities (ID) often experience communication problems (Chew, Iacono, & Tracy, 2009; Hatton, 1998; Rice, Warren, & Betz, 2005; Rondal, 2001). Estimations of the prevalence of these problems vary from 23% up to 74%, and are related to degree of ID, aetiology, and related disorders (e.g., motor, behaviour, and sensory impairments; Blackwell et al., 1989; Bray, 2003). Augmentative and alternative communication (AAC) refers to all possible forms of communication that can be used to support individuals with communication problems (American Speech-Language-Hearing Association, 2005). AAC systems can be described as aided, e.g., graphic symbols, or unaided systems, e.g., manual signing. Manual signing is frequently used in both children and adults with ID, often combined with other means of AAC (Meuris, Maes, & Zink, in press; Schlosser & Sigafoos, 2006). Several studies have pointed out that using manual signs can have positive effects not only on communicative skills (e.g., increased communication in adults with ID; Conaghan, Singh, Moe, Landrum, & Ellis, 1992), but also on social behaviour (e.g., increase in social behaviour in pre-schoolers with severe disabilities; Kouri, 1988), and that it certainly does not impede speech production (for a review: see Millar, Light, & Schlosser, 2006). Also, adults with ID have been found capable of learning manual signs, even if their first experience with manual signs only occurred in adulthood (e.g., Elias, Goyos, Saunders, & Saunders, 2008).

6.1.1. Augmented input

Most research on the use of manual signs in adults with ID focuses on teaching signs as an aid in expressive communication, using direct instruction (e.g., Dalrymple & Feldman, 1992; Elias et al., 2008; Miller, Collins, & Hemmeter, 2002; Palmer, Collins, & Schuster, 1999). Many adults with ID however, do not (only) experience problems with verbal language production, but also with language comprehension, and require communication support accordingly (Romski & Sevcik, 1988). Also, the dichotomy between the language input provided by the communication partner (usually spoken language) and the language output of the AAC user (usually a visually symbolic language system, e.g., graphics and manual signs), is a problem that is often encountered in AAC interventions (Dada & Alant, 2009; Dodd & Gorey, 2014; Sevcik, Romski, Watkins, & Deffebach, 1995; Smith & Grove, 2003). Key word signing (KWS), an unaided AAC system using manual signs, specifically addresses these two issues. When using KWS, the key words in a spoken sentence are simultaneously supported by manual signs (Windsor & Fristoe, 1989). This way, communication partners offer the same language input as what the KWS user is expected to produce as language output. This approach more generally has been described as augmented input (Romski & Sevcik, 1988), total communication (in relation to unaided AAC; Beukelman & Mirenda, 2005), or aided language stimulation (in relation to aided AAC; see Beukelman & Mirenda, 2005, for an overview). Communication partners who use KWS, and augmented input in general, provide a model for the person who needs communication support. Such a model can serve many purposes: it can be a model for vocabulary expansion, a model of how the AAC system can be employed, of the potential power and utility of the system, and of the fact that the AAC system is an acceptable and encouraged way of communicating (Dada & Alant, 2009; Drager et al., 2006; Romski & Sevcik, 1988; Sevcik et al., 1995). Augmented input also offers a potential enhancement of the comprehension of the verbal message, by offering a multimodal input (Loncke, Campbell, England, & Haley, 2006). Finally, it creates a greater symmetry between the receptive and expressive modality of the AAC user (Dada & Alant, 2009; Dodd & Gorey, 2014; Grove & Smith, 1997; Sevcik et al., 1995). Augmented input interventions have been found to successfully increase symbol comprehension and production, communication effectiveness, and responsiveness, in both children and adults with moderate to severe ID and children with autism (Beck, Stoner, & Dennis, 2009; Dada & Alant, 2009; Drager et al., 2006; Harris & Reichle, 2004; Romski, Sevcik, Robinson, & Bakeman, 1994).

6.1.2. Immersion model

Most AAC intervention studies, still, are aimed at teaching a small set of symbols (be it graphic or manual signs) to individuals with communication problems through direct instruction, and evaluating the expressive use of these symbols in structured settings and for a limited number of communicative functions (mostly naming or manding), without paying attention to the functional use of the symbols during typical daily interactions (Romski et al., 1994). Augmented input, on the contrary, advocates a total immersion approach, wherein the AAC system is taught to the client in an unstrained way, within the natural environment (Beukelman & Mirenda, 2005; Harris & Reichle, 2004). An immersion model, specifically in an adult population, has some advantages over direct instruction models, such as individual therapy. First, practical issues often impede the feasibility of such direct interventions. Individual therapy requires the presence of a therapist, which in turn, requires time and money, both of which are often lacking in services for adults with ID (Meuris et al., in press). Immersion interventions do not require individual therapy time, can be implemented by available support staff within everyday activities, and therefore seem more feasible in practice. Second, an immersion model more closely resembles the natural way in which typically developing children acquire language: by being totally immersed in it (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Sevcik et al., 1995). People with ID for a long time have been assumed to need repeated and structured drill in order to acquire and maintain symbol skills, but research has shown that they, too, are capable of learning language through observation (Beukelman & Mirenda, 2005; Romski, et al., 1994). Third, an immersion model creates multiple opportunities for the AAC user to communicate using his or her means of AAC in natural interactions (Dodd & Gorey, 2014; Romski & Sevcik, 1988) and thus focuses on functional communication, which, according to the National Joint Committee for the Communication Needs of Persons with Severe Disabilities (1992), should indeed be the main point of attention of an AAC intervention for adults with ID. And finally, immersion interventions using KWS have been found effective in teaching manual signs to adults with ID through their support staff.

6.1.3. Teaching manual signs to adults with ID and their support staff using KWS

Most studies that have been published on teaching KWS to support workers and their clients, combined direct instruction with an immersion approach. Fitzgerald et al. (1984) taught 34 manual signs to six support workers in three to four 30- to 40-minute sessions (using verbal instruction, modelling, practice in isolation, and verbal feedback, and a manual with drawings and written instructions of the signs). The same six support workers were taught to teach 9 of these 34 signs to six of their adolescent clients with profound ID, through direct instruction and by modelling KWS throughout the day (Faw, Reid, Schepis, Fitzgerald, &Welty, 1981). All clients learned to use the signs to name (pictures of) objects (and maintained this skill at a 9 to 11 month follow-up), but did not increase their sign use during spontaneous communication. Staff did use the signs during 15% of the observed spontaneous interactions. Schepis et al. (1982) applied a similar procedure, supplemented with modified incidental teaching strategies, to let 15 support staff teach nine adolescents with developmental disabilities 17 manual signs. Staff perceived the intervention as very useful, and their clients did show an increased sign production during spontaneous communication, which was maintained at a 1 to 4 month follow-up. Loeding, Zangari, and Lloyd (1990) also described a method to teach KWS to staff members in a school for severely disabled students, using four half-day workshops (with print and video materials). Spragale and Miccuci (1990) developed a “signs of the week” program in which two signs per week were taught to support staff in a residential service for adults with ID. These authors did not, however, evaluate the effectiveness of their program. Chadwick and Jolliffe (2009) implemented a KWS training for support staff of adults with ID as well. Twenty manual signs were taught to the staff in one training session (using modelling, practice in isolation and in sentences, a video, and a card with photographs of the signs). Trained support staff produced the signs significantly more accurate at a 6 to 12 month follow-up compared to an untrained control group. Staff perceived the training as very effective, and the photograph card as more effective than the video. Most of the participants however, indicated to have used the signs only occasionally to rarely in daily communication with their clients. Sign production of these clients was not evaluated.

In conclusion, some programs for teaching KWS to adolescents and adults with ID through their support staff and in their everyday environment have been developed, and have shown satisfying results. However, data on the effectiveness of these programs with regard to the KWS production of the participating staff in everyday communication are often lacking. Also, most studies did not evaluate the spontaneous KWS use of the adults with ID who were involved. Because in most studies one of the ultimate objectives, besides teaching KWS to support staff, was for the adults with ID to learn to use manual signs, it seems relevant to evaluate their KWS use during functional communication as well.

6.1.4. Current study

The main goal of this study was to evaluate the implementation of a KWS immersion program in a residential and day care service for adults with mild to severe ID. The purpose of this program was for them to learn to use KWS in functional communication, through their support staff. We hypothesize that the program will be successful in:

- teaching support staff to use KWS during everyday communication with their clients;
- teaching their clients, adults with mild to severe ID, to use KWS during everyday communication through continuous modelling of their support staff;
- teaching the clients to use KWS in a variety of communicative functions.

6.2. Methods

6.2.1. Design

This immersion intervention study used a one group pretest-posttest design. A KWS program was set up to introduce KWS into a service for adults with ID. First, eight KWS ambassadors, during the course of 2 months, attended four 2-hour workshops in which they were taught KWS. Thereafter they introduced KWS at a rate of two signs per week to their colleague support workers, who subsequently modelled KWS towards their clients. The KWS production of 15 participating clients and their support workers was evaluated before (while the workshops took place), and 12 months after the start of the service-wide implementation of the KWS program, during a natural conversation between client and support worker. KWS use of the clients was additionally evaluated using a narrative task, in which not only verbal and manual sign production were evaluated, but the use of both language modes to recall and express communicative functions as well. This study was approved by the KU Leuven Medical Ethical Committee.

6.2.2. Participants

6.2.2.1. Residential and day care service

KWS was introduced in a residential and day care service for adults with mild to severe ID in Flanders, the northern Dutch-speaking part of Belgium with over 6 million inhabitants. A total of 42 adults made use of the residential program at the time of this study (living in five different houses), and 51 adults made use of the day care program (living at home with their parents). KWS was not yet used with any client in this service, but for some clients, the need for other forms of AAC besides for example visual support through graphic symbols was present.

6.2.2.2. Adults with ID

Fifteen adults with ID gave their informed consent (in addition to that of their parents or caregivers) to participate in this study. They all had an acute need for communication support, as determined by the psychologist of the service in close consultation with their support workers and parents or caregivers. The only inclusion criterion was being an adult (> 18 years of age) with a congenital ID. Exclusion criteria were: having an uncorrected visual or auditory impairment and having dementia. An overview of the personal characteristics of the participants can be found in Table 6.1. Appendix G gives additional case information for each participant. Receptive and expressive communication, imitation, and motor skills of the participants were evaluated before the intervention and can be found in Table 6.1 as well. Most participants (n = 12) needed support because they experienced expressive and/or receptive communication problems, with frequent communication breakdowns, which often led to frustration and challenging behaviour. Three participants (clients 11, 13, and 14) wanted to learn KWS to communicate with their peers who were in need of communication support. None of the clients received individual

Table 6.1. Personal characteristics of participating adults with ID (*N* = 15).

Nr	**Age**[1]	**IQ**[2]	**RP or DP**	**Etiology**	**MP**	**RCP**	**ECP**		**ComFor**[3]	**PPVT**[4]	**CPZ**[5]		**PIPS**[6]	**NESS**[7]
							Art	**Lan**			**Rec**	**Exp**		
1	37	27	RP	Other	LL	X	/	X	-1,89	< 2;3	46	32	46	60
2	74	27	RP	Other	WC	X	X	X	-1,48	2;5	40	31	57	82
3	35	28	RP	Other	UL	X	/	X	-1,63	3;8	44	31	54	35
4	53	31	RP	Other	LL	X	X	X	-1,36	2;11	42	35	56	66
5	39	32	RP	DS	/	L	X	X	0,40	5;3	53	38	74	46
6	34	34	DP	DS	/	L	X	X	0,46	5;7	50	34	69	59
7	57	42	DP	Other	UL	X	X	X	0,46	2;11	40	38	70	54
8	60	42	RP	Other	UL WC	X	X	X	0,65	3;8	55	39	56	66
9	45	45	RP	Other	UL LL	L	X	X	0,65	9;6	55	39	54	66
10	47	48	RP	DS	/	X	/	L	0,46	3;8	49	36	70	52
11	56	51	RP	Other	/	L	/	L	0,65	7;6	55	40	70	39
12	64	51	RP	Other	/	X	/	L	0,65	5;0	54	37	61	62
13	50	57	RP	Other	/	L	/	L	0,65	13;0	55	40	74	47
14	59	59	RP	Other	WC	L	/	L	0,65	9;6	55	39	66	72
15	56	68	RP	Other	/	X	X	L	0,65	6;0	53	38	74	29
M	51.07	42.80							0.00	5;6	49.73	36.47	63.40	55.67
SD	11.56	12.87							1.00	3;1	5.82	3.16	9.03	14.49

Note. ID = intellectual disability; Nr = identification number; RP = residential program; DP = day care program; MP = motoric problems; RCP = receptive communication problems; ECP = expressive communication problems; Art = articulation; Lan = language; ComFor = Forerunners in Communication (Verpoorten, Noens, & van Berckelaer-Onnes, 2004); PPVT = Peabody Picture Vocabulary Test-III-NL (Dunn & Dunn, 2005); CPZ = Communication-Profile-Z (Willems & Verpoorten, 1996); Rec = receptive communication; Exp = expressive communication; PIPS = Preschool Imitation and Praxis Scale (Vanvuchelen, 2006); NESS = Revised Neurological Examination for Subtle Signs (Denkla, 1984); DS = Down syndrome; LL = weakness of the lower limbs; WC = wheelchair; UL = gross motor problems of the upper limbs; / = no problems; X = severe problems reported in personal file; L = little problems

[1] age at the start of the implementation of the KWS program
[2] most recent IQ-test results available, as measured by the psychologist of the service using the Wechsler Adult Intelligence Scale (WAIS, Wechsler, 2012), Wechsler Preschool and Primary Scale of Intelligence (WPPSI, Wechsler, 2011) or Stanford-Binet intelligence scale (Terman, Merrill, & Pinneau, 1962)
[3] ComFor is a clinical instrument for forerunners of communication. As the ComFor is an action-oriented test, principal component analysis was used to derive one outcome score.
[4] PPVT is a receptive vocabulary test. Age equivalents are given,
[5] CPZ is the only available standardized Dutch language and communication test for adults with ID. It addresses both nonverbal and verbal communication. Rec gives the raw score for receptive communication (maximal score of 55) and exp for expressive communication (maximal score of 40).
[6] PIPS is a test that was developed to evaluate motor imitation skills in children with ASD (Vanvuchelen, Roeyers, & De Weerdt, 2011), but has also been used in children and adults with ID (Meuris, Maes, & Zink, 2014; Vanvuchelen, & Vochten, 2011; Vanvuchelen, Feys, & De Weerdt, 2011). Raw scores (between 0 and 81) are given.
[7] The subtest Timed Coordination of NESS was used to evaluate the motor abilities of the upper limbs. This test does not rely on scholastic skills. Three items, in which participants are asked to tap with the hands (hand palm and pronation/supination) and fingers (index finger on thumb) were included. The score is the total time needed (in seconds) to produce 20 movement repetitions for each included item and for the left and right hand.

communication therapy during this study. Two participants, clients 3 and 15, had learned some manual signs at school as a child, but used them infrequently as none of the support workers understood these signs. The other 13 participants had never received training in manual signing.

6.2.2.3. Support staff

Eight persons took part in the KWS workshops (the psychologist, one support worker responsible for the day care program, and one to two responsible for each of the five residential groups). They participated voluntarily, and became the service's KWS ambassadors. There were six women and two men, with a mean age of 36.57 years (minimum 26, maximum 50, *SD* = 9.69). They all had worked for the service for a minimum of 1 year. One KWS ambassador went on a 3 month maternity leave during the course of the program, but another KWS ambassador was present in her residential group. Another 15 support workers, one per participating client, participated in the KWS evaluations before implementation of the program, and at a 12-month follow-up. They all had completed at least an undergraduate course, and had worked for the service and known their clients for a minimum of 1 year. These 15 support workers were continuously employed during the 12 month implementation of the KWS program. There were 13 women and two men, with a mean age of 32.67 years (minimum 27, maximum 42, *SD* = 4.12).

6.2.3. Materials and procedure

More detailed information concerning the KWS program and the developed materials, can be consulted in Appendix H.

6.2.3.1. KWS program

The development of the KWS program, with a thorough pretesting in a group of 49 student support workers, has been described in Meuris, Maes, and Zink (2012b) and Rombouts, Meuris, Maes, De Meyer, and Zink (2014). The KWS program was based on four principles: the appointment of eight KWS ambassadors who received an intensive KWS training and who further implemented the program service wide, a signs of the week approach in which two signs per week were introduced to all support workers and clients of the service, augmented input in which the learned signs were modelled using KWS by the support workers towards their clients, and a total immersion approach in which KWS was used by all support workers, on all relevant occasions in natural communication with their clients. The KWS ambassadors training consisted of four 2-hour workshops. These workshops included a theoretical introduction to AAC and KWS, and teaching and practicing of 100 manual signs, both in isolation and in spontaneous communication. Methods used included photo, video, written and verbal instructions for the 100 signs, modelling, practice, and verbal and video feedback. The 100 selected signs were the manual signs that were most frequently used by Flemish adults with ID according to a questionnaire study (Meuris, Maes, & Zink, 2012a; see Appendix I). After their training, KWS ambassadors implemented the KWS program service wide by teaching two signs per week to all support staff (at team meetings) and clients (at client meetings). Visual reminders with photographs of the signs were displayed in the groups, and signs that had already been taught, were frequently refreshed. KWS ambassadors kept a logbook to record this process (see Appendix J). Twelve months after the start of the implementation, all 100 manual signs had been introduced.

6.2.3.2. KWS evaluation

Before and 12 months after the start of the service-wide implementation of the KWS program, we evaluated the functional KWS use of our participants during natural communication. The 15 participating adults with ID and their support workers engaged in a 5-minute spontaneous conversation. We used a procedure similar to one described by Abbeduto, Benson, Short and Dolish (1995; see Appendix K). The verbal language produced by both support workers and their clients was transcribed literally and divided into distinctive utterances (we used a procedure similar to that used in the Bus Story Test [Renfrew, 1997], that has been shown to possess an excellent inter-rater reliability [Meuris, Maes, & Zink, 2014]). Manual signs were also transcribed and divided into utterances in connection with the verbal language they supported, or, in case of signs produced without verbal language, as separate utterances (with distinctive utterances determined by a pause of 5 or more seconds between the signs). Manual signs needed to be performed with minimum two out of three main sign characteristics (hand shape, movement, and/or location) correct, in order to be included (as described in the phonological analysis of the Flemish KWS system; Meuris, Maes, De Meyer, & Zink, 2014). Direct repetitions by the client of signs produced by the support worker were excluded from analysis. Outcome measures that were taken into account were: number of sign utterances, number of signs, and number of different signs produced; and number of verbal utterances, number of words, and number of different words produced.

In the adults with ID, additionally, a narrative task specifically developed for KWS users was administered (see Meuris, Maes, & Zink, 2014, for more information concerning development, administration, and scoring of the task). This story retelling task with support of pictures, built up using the story grammar scheme of Stein and Glenn (1979, in Merritt & Liles, 1987), results in a story grammar score, which valorises the communicative functions that are expressed in the story (settings, initiating events, internal responses, attempts, direct consequences, and reactions), and thus how well the story is understood and reproduced, as a score from 0 to 72. The task possesses an excellent inter-rater reliability, and results on the task in adults with ID have been found to correlate significantly and highly with spontaneous KWS production during conversation (Meuris, Maes, & Zink, 2014). All verbal language and manual signs produced by the participants were transcribed and prepared for analysis using the same procedure as described for the conversation, and using the same outcome measures. Additionally, story grammar scores for both verbal language and KWS were calculated to give an account of the understanding of the story and the communicative functions expressed in the narratives.

The narrative task and the conversation were carried out in a quiet room in the residence or day care centre of the client. They were videotaped using two cameras (JVC GZ-HD520). During the narrative task, the test leader and the client were seated opposite of each other. During the conversation, the client and his/her support worker were seated at an angle of 90 degrees. The exact timing of the posttest was not communicated to the support staff, so they were unable to especially practice the signs right before the conversation took place. Also, the exact purposes of the conversation and the narrative task were not communicated to the participants, in an effort to keep the communication as natural as possible.

6.2.3.3. Statistical analysis

To explore whether or not the support staff and their clients had successfully acquired KWS, sign measures before and 12 months after the implementation of the KWS program were compared using Wilcoxon signed ranks tests (because most of the variables, as evaluated with Shapiro-Wilk tests, had a nonnormal distribution; $p < .05$). Wilcoxon signed ranks tests were also used to evaluate the possible differences in verbal measures before and after the intervention, and the communicative functions expressed, both verbally and using KWS, in the narrative task by the adults with ID. Because of the small sample size ($N = 15$), in an effort not to increase the chance for type II errors too much, no Bonferroni corrections were applied (Nakagawa, 2004). Rather, we decided to report effect sizes (ES) for the reader to be able to evaluate the strength of the observed relationships (Sullivan & Feinn, 2012). Analyses were performed using SPSS and alpha was set at .05.

6.3. Results

6.3.1. Manual sign and verbal language production by support staff

Results with regard to the sign production of the support staff can be found in Table 6.2 and Figure 6.1. Because one of the participating clients was unable to take part in the conversation posttest due to illness, the results of 14 of the 15 support worker-client pairs were included in the analysis. As can be seen in Table 6.2, staff produced significantly more sign utterances, signs, and different signs after the intervention. A large effect size of .60 was found for all three measures. The verbal language of the support staff was evaluated as well, and results can be found in Table 6.3 and Figure 6.1. Wilcoxon signed rank tests revealed no significant differences between pre- and posttest measures.

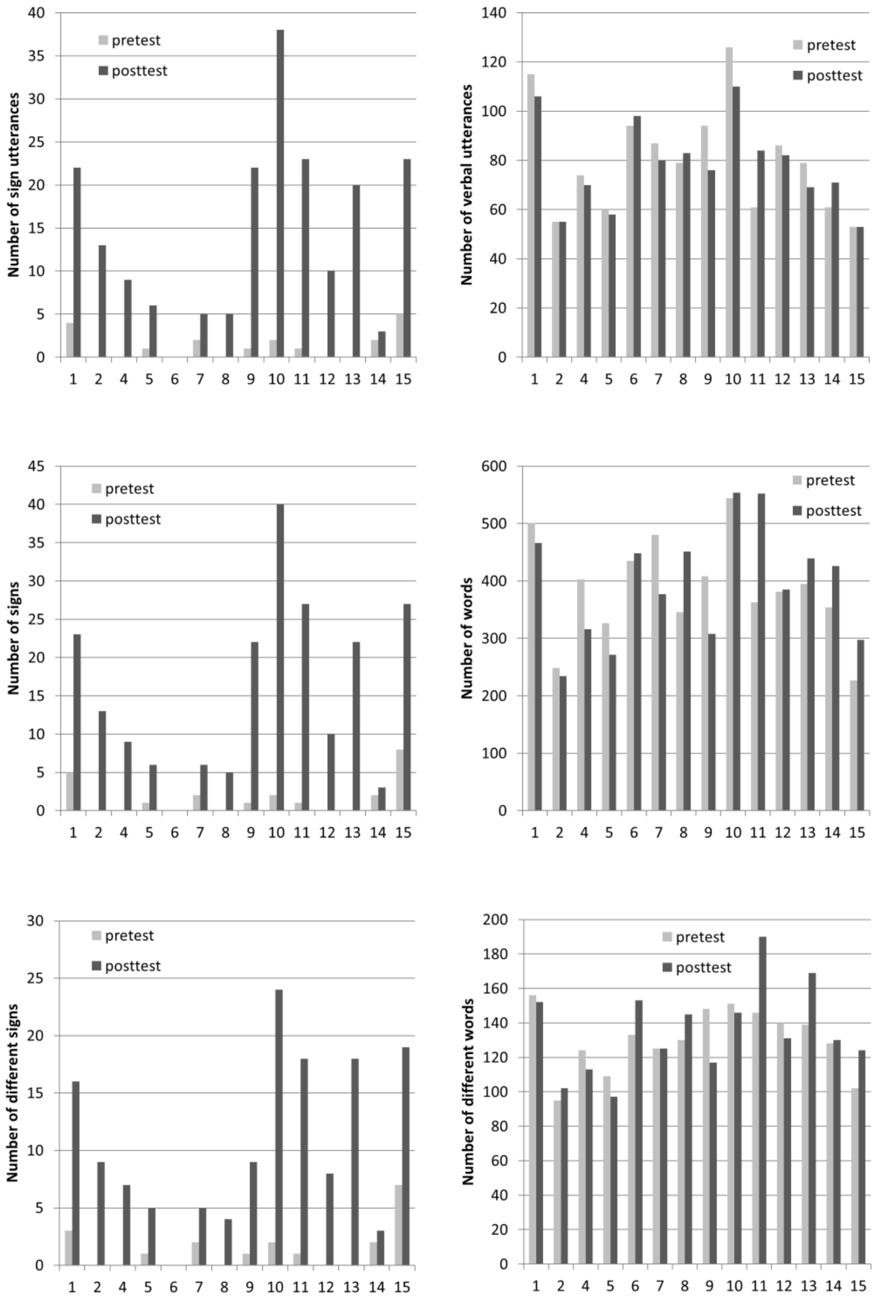

Figure 6.1. Manual sign and verbal language production by support staff during conversation.

Table 6.2. Manual sign production by support staff (N = 14) during conversation.

Measure	M	SD	Min - Max	Wilcoxon signed rank test
Number of sign utterances				$T = 0.00$, $p < .05$, ES = .60
before intervention	1.29	1.59	0 - 5	
after intervention	14.21	10.69	0 - 38	
Number of signs				$T = 0.00$, $p < .05$, ES = .60
before intervention	1.57	2.31	0 - 8	
after intervention	15.21	11.67	0 - 40	
Number of different signs				$T = 0.00$, $p < .05$, ES = .60
before intervention	1.36	1.91	0 - 7	
after intervention	10.36	7.28	0 - 24	

Note. Min = minimum; Max = maximum; ES = effect size.

Table 6.3. Verbal language production by support staff (N = 14) during conversation.

Measure	M	SD	Min - Max	Wilcoxon signed rank test
Number of verbal utterances				$T = 27.50$, ns, ES = .17
before intervention	80.29	22.07	53 - 126	
after intervention	78.21	17.63	53 - 110	
Number of words				$T = 49.00$, ns, ES = .04
before intervention	386.50	88.31	227 - 544	
after intervention	394.57	99.59	234 - 554	
Number of different words				$T = 35.00$, ns, ES = .14
before intervention	130.43	18.40	95 - 156	
after intervention	135.29	25.75	97 - 190	

Note. Min = minimum; Max = maximum; ns = nonsignificant; ES = effect size.

6.3.2. Manual sign and verbal language production by adults with ID

Sign production by the adults with ID was measured not only during the 5-minute conversation with their support staff, but using a narrative task as well. These narratives lasted from 100 to 198 seconds in the pretest (M = 142.21, SD = 30.76) and from 126 to 200 seconds in the posttest condition (M = 157.43, SD = 23.76). No significant difference in length of narratives pre- and posttest was found (T = 26.50, *ns*). Because both during the conversation posttest as during the narrative task posttest, one client could not participate due to illness (two different clients), only 14 clients were included in each analysis. Results are displayed in Table 6.4 and Figures 6.2 and 6.3. Clients produced significantly more sign utterances, signs, and different signs after the intervention in both conditions. Effect sizes of .40 and higher were found. Verbal language was also evaluated during the narrative task and the conversation. Results can be found

Table 6.4. Manual sign production by adults with ID (N = 14) during conversation and narrative task.

Measure	M	SD	Min - Max	Wilcoxon signed rank test
		Narrative task		
Number of sign utterances				T = 9.00, p < .05, ES = .41
before intervention	1.57	2.07	0 - 6	
after intervention	4.14	4.00	0 - 12	
Number of signs				T = 9.00, p < .05, ES = .40
before intervention	1.64	2.10	0 - 6	
after intervention	4.64	4.57	0 - 13	
Number of different signs				T = 8.00, p < .05, ES = .42
before intervention	1.36	1.78	0 - 6	
after intervention	3.21	3.04	0 - 8	
		Conversation		
Number of sign utterances				T = 19.00, p < .05, ES = .40
before intervention	3.14	3.44	0 - 9	
after intervention	6.93	6.52	0 - 24	
Number of signs				T = 19.00, p < .05, ES = .40
before intervention	3.21	3.58	0 - 10	
after intervention	7.00	6.58	0 - 24	
Number of different signs				T = 14.50, p < .05, ES = .45
before intervention	2.00	2.51	0 - 9	
after intervention	4.86	4.00	0 - 13	

Note. Min = minimum; Max = maximum; ES = effect size.

Table 6.5. Verbal language production by adults with ID (N = 14) during conversation and narrative task.

Measure	M	SD	Min - Max	Wilcoxon signed rank test
		Narrative task		
Number of verbal utterances				T = 23.00, ns, ES = .24
before intervention	16.79	4.98	9 - 29	
after intervention	19.71	6.15	12 - 36	
Number of words				T = 19.50, p < .05, ES = .39
before intervention	63.57	35.66	28 - 149	
after intervention	76.07	29.19	40 - 141	
Number of different words				T = 19.00, p < .05, ES = .40
before intervention	30.79	18.91	10 - 85	
after intervention	36.07	13.74	21 - 68	
		Conversation		
Number of verbal utterances				T = 37.00, ns, ES = .18
before intervention	45.07	13.56	22 - 72	
after intervention	37.64	12.96	12 - 56	
Number of words				T = 21.50, ns, ES = .37
before intervention	141.93	68.08	38 - 278	
after intervention	103.43	54.69	27 - 220	
Number of different words				T = 26.50, ns, ES = .31
before intervention	75.86	25.50	33 - 127	
after intervention	58.50	24.30	23 - 105	

Note. Min = minimum; Max = maximum; ns = nonsignificant; ES = effect size.

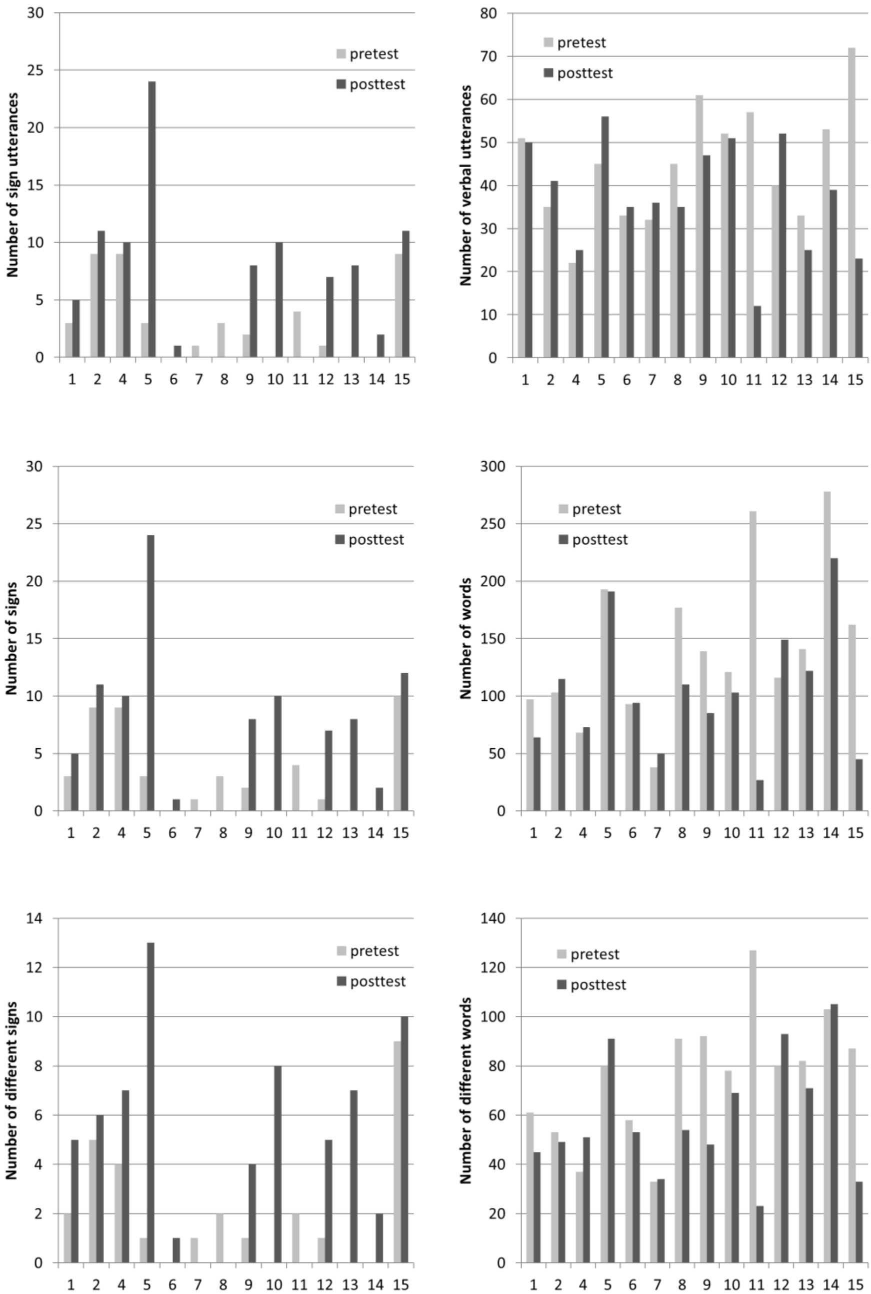

Figure 6.2. Manual sign and verbal language production by adults with ID during conversation.

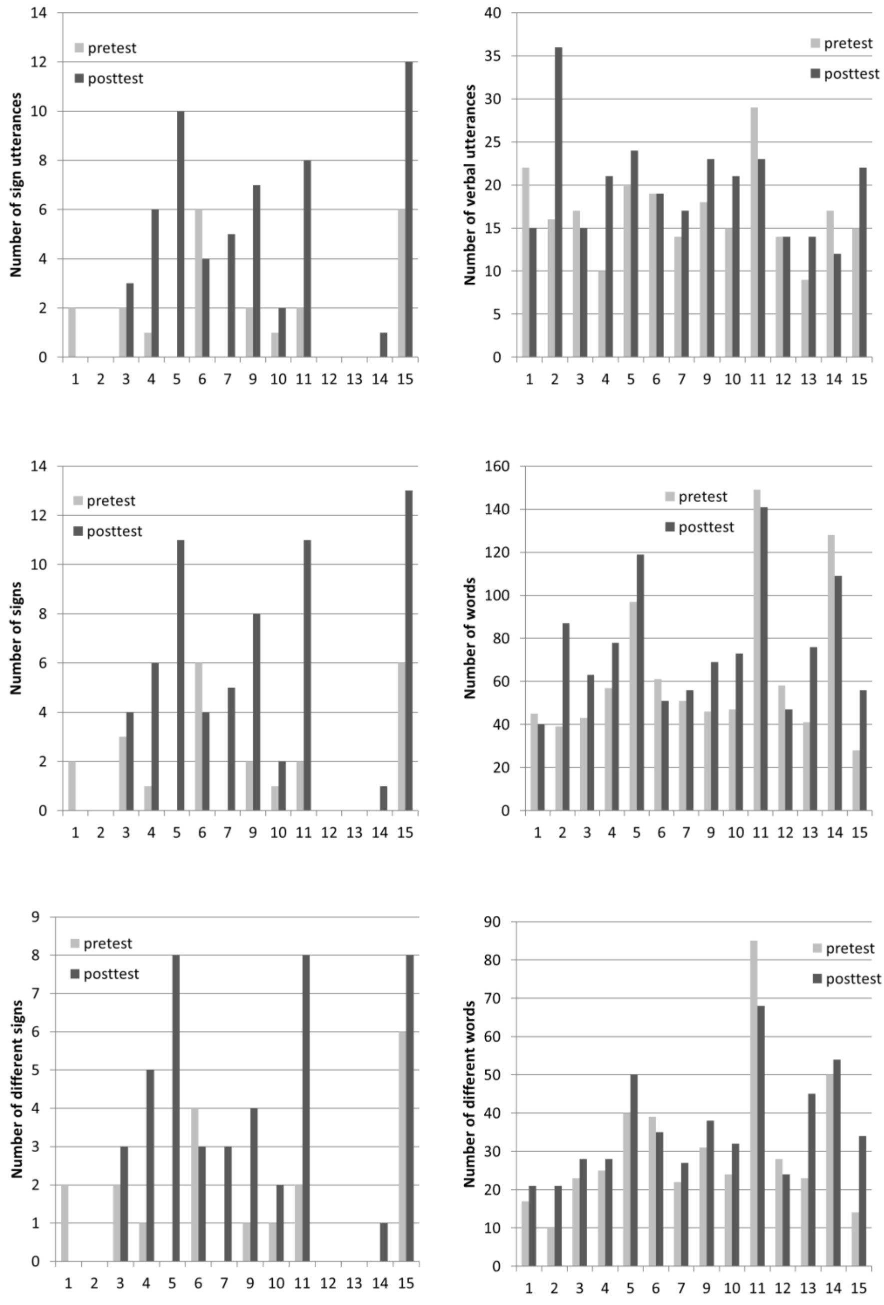

Figure 6.3. Manual sign and verbal language production by adults with ID during narrative task.

in Table 6.5 and Figures 6.2 and 6.3. Significant differences between pre- and posttest measures were found for the number of words and number of different words produced during the narrative task, but not during the conversation.

Finally, story grammar scores for verbal language and KWS were calculated and can be found in Table 6. Verbal (unsupported by manual signs) story grammar scores did not differ significantly before and after the intervention (T = 32.50, *ns*, ES = -.24). KWS story grammar scores after the intervention however, were significantly higher compared to pretest measures (T = 13.00, $p < .05$, ES = -.55). Also, KWS scores were significantly higher compared to verbal language scores, both before (T = 0.00, $p < .05$, ES = -.63) and after the intervention (T = 0.00, $p < .05$, ES = -.75).

Table 6.6. Story grammar scores of adults with ID ($N = 14$).

Nr	Story grammar score[1]			
	Before intervention		After intervention	
	Verbal language[2]	KWS[3]	Verbal language	KWS
1	7	8	8	8
2	6	6	7	7
3	6	8	8	10
4	11	12	24	28
5	26	26	26	35
6	24	29	20	23
7	14	14	29	32
9	12	13	8	15
10	19	20	20	22
11	27	27	22	28
12	21	21	16	16
13	15	15	26	26
14	21	21	20	21
15	8	11	19	28
M	15.50	16.50	18.07	21.36
SD	7.50	7.52	7.54	8.94

Note. ID = intellectual disability; Nr = identification number; KWS = key word signing
[1] Maximum story grammar score = 72
[2] Scores when only taking verbal language without support of manual signs into account
[3] Scores taking into account verbal language and manual signing

6.4. Discussion

In this study, a KWS program was implemented in a service for adults with mild to severe ID. In four 2-hour workshops, KWS was taught to eight KWS ambassadors who introduced KWS to their colleagues and clients in a signs of the week, total immersion approach. KWS production of 15 adults with ID and their support workers was evaluated before the intervention, and at a 12-month follow-up. A significant increase in sign production was found for both the participating support workers and their clients during conversation and in a narrative task. Almost all participants produced more sign utterances, more signs, and a higher diversity of signs after the intervention. This suggests that the KWS program was successful, but, as this is a one group only pretest-posttest design study, our methodology does not permit strong conclusions. On the other hand, it seems highly unlikely that the found increase in sign production cannot be attributed to the KWS program. Because our participants all were adults, chances are quite small that they developed the acquired signing skills due to maturation. Also, because none of the participants received individual communication therapy, sign acquisition cannot be attributed to such either. Therefore, we do dare to call this a very positive result. It suggests that a group of support workers who received an 8-hour KWS training, can successfully implement a KWS program, which enables both support workers and adults with mild to severe ID to learn using KWS in spontaneous communication. This result is hopeful for services who lack resources to offer individual therapy to their clients, and it shows that support workers are capable of learning KWS, teaching it to their colleagues and clients, and applying it in spontaneous communication. It also shows that it is definitely worthwhile to teach adults with ID new communication skills if they experience communication problems, because they certainly have the potential to learn to use those new skills functionally.

When we look at the individual participants in more detail, it is apparent that quite large differences in performance did exist, both among support staff and among the adults with ID. Support worker 6 did not produce any manual signs, whereas support worker 10 produced an exceptional number of signs. Support workers 5, 7, 8, and 14 also produced only few signs. These results did not seem related to the support workers' personal characteristics that were available to us (age, gender, education, and experience), so can likely be attributed to personality traits, motivational issues, or the attitude of the support workers. An immersion model does imply certain challenges for the professionals involved. They must commit to the program, make an effort to learn the manual signs and constantly be alert to use them consequently (Dodd & Gorey, 2014). This might have caused difficulties for some participants. In this study, systematic attitude measures of participants were not undertaken. However, attitude of support staff can be an important contributing factor in relation to KWS use (Bryen & Joyce, 1986; Bryen & McGinley, 1991; Meuris et al., in press). During the development of the KWS program, we did attempt to measure attitude changes in our participants, but no differences in attitude measurements were found between pre- and posttest measures, nor were any relations found between attitude measures and manual signing acquisition (Rombouts, Meuris, Maes, & Zink, 2014). Because a questionnaire was used to assess attitude towards KWS, these results could have been attributed to self-report bias, or to validity issues with the developed questionnaire. We therefore decided not to use the questionnaire in the current study, and only evaluated the attitude of our participants informally. Most participating support workers indicated that they enjoyed the KWS program and that they perceived KWS as very useful. The psychologist of the service also indicated that KWS had become an evidence for many support workers and clients (see Appendix J). Support worker 5 and 6 did indicate to be embarrassed to use signs during the posttest conversation, whereas support worker 10 was a very enthusiastic and highly motivated participant. Support workers 7, 8, and 14 however, did not seem too convinced that their clients could benefit from their KWS use. These results indicate that staff attitude remains a considerable variable within this topic, and both methods to evaluate staff attitude as programs aimed at influencing it, should be put on the agenda for future research.

Differences in manual sign production also existed across the participating adults with ID. These differences might be related to personal characteristics of the participants, to their motivation (Bryen & Joyce, 1986), and to personal events that occurred during the intervention. Clients 6, 7, 8, 11, and 14 produced very little to no manual signs during the conversation. Clients 6, 7, and 11 did, however, produce a number of signs during the narrative task. Client 8 did not participate in the narrative task due to illness, so his result cannot be compared to other situations. He had some temper issues and it was difficult to engage in a positive conversation with him, despite efforts of his support worker, which could explain why he did not produce any signs. Also, as client 8 had one of the lowest imitation scores and worst performances on the motor test (both of which have been related to manual sign production in individuals with ID; Gregory, DeLeon, & Richman, 2009; Marquardt, Sanchez, & Muñoz, 1999), manual signing could have been an unsuitable means of AAC for him. Client 6 had indicated not to be very keen on using manual signs before the intervention, and probably was not motivated enough to use KWS during the conversation, although she did use some signs in the narrative task. The lack of sign production by client 7 during conversation, could be related to the many yes/no question asked by his support worker (despite instructions). Client 11 suffered from the loss of a close family member who had just passed away, and possibly did not produce any signs because he was very emotional at the posttest conversation. He also wanted to learn KWS mainly to communicate with his peers, so possibly did not feel the need to use signs with his support worker. The same applied to client 14. Support staff did report that he used signs when conversing with his peers. Clients 1, 2, 12, and 13 did use manual signs during the conversation, but not during the narrative task. This task possibly was too difficult for clients 1 and 2, as these were also the clients with the lowest IQ and ComFor scores. They also had a low score on the imitation task, and, because a narrative task relies more on imitation compared to a conversation, this might also have contributed to their lack of manual sign use. For client 12 and 13, on the other hand, the story might have been too simple to feel the need to use manual signs. Client 13 did show a very large increase in story grammar score after the intervention, so although she did not produce any manual signs herself, the modelled manual signs possibly did support her comprehension of the story. This large gain in story grammar score post intervention was also true for clients 4, 5, 7, 9, and 15, who probably made use of the modelled KWS for receptive language support as well. Clients 5 and 15 also produced a very large number of signs both during conversation and during the narrative task. These two participants responded especially well to the KWS program. Client 5 was a man with Down syndrome (DS), who had a very good imitation score and performed well on the motor test. Client 15 also scored very well on the imitation and motor tests, and had learned manual signs in his childhood, so he had some experience using signs.

Although all but one client learned to use KWS in spontaneous communication, one might wonder if KWS really was a useful means of AAC for these clients. Of course, we cannot measure if the use of KWS by the support workers actually helped the clients to understand them. Most support workers did produce signs during spontaneous conversation, and indicated that they experienced KWS as being useful. Also, as the story grammar scores of many participants were significantly larger posttest, this could indicate that KWS supported them in their understanding of the story. However, this was not directly measured in this study and should be addressed in future research. We might also assume, as almost all clients spontaneously started to use KWS in narratives and during conversation, that it helped them to express themselves. The quality of the narratives in this study was addressed in terms of story grammar scores, and number of different words and signs produced, but could be studied in more detail in future research (e.g., in terms of coherence and use of linguistic references). The significant increase in story grammar scores after the intervention and when KWS was included, indicates that participants were better capable of expressing the communicative functions of the story with KWS. The significant increase in number of words and number of different words produced in the posttest narratives suggests that the use of KWS helped the clients to better express themselves verbally as well. This increase was not found in the posttest conversation where, although not significant, a decrease in number of verbal utterances, number of words, and number of different words produced, could be noted. This result might be associated with the high level of verbality of the support workers. Although they did produce significantly more sign utterances, signs, and different signs after the intervention, the support workers did not adapt their verbal language accordingly (no significant difference between verbal language before and after the intervention). When using KWS, a simple and clear use of verbal language is suggested (Loncke et al., 1998). When this is not done, there is a risk that support workers overwhelm their clients with their verbal overweight (Bradshaw, 2001; McConkey, Morris, & Purcell, 1999). This issue should be addressed in future research.

The results of this study should be interpreted with care. First, the design of this study, a one group pretest-posttest design, does not allow strong conclusions. A control group or multiple baseline design could have been good alternatives, but because of the urgent need for communication support in this service, would have implied ethical issues. A longitudinal study with multiple posttests could be a possible alternative for future studies. Second, the experimenter was privy to the purpose of the study, which could have caused experimenter bias. In future studies, experimenters could be blinded to increase objectivity. Third, the sample size is quite small. This also was determined by practical issues, but could possibly be extended in future comparable studies. Fourth, visual attention and attention span of the participants could have affected the results, but was not measured in this study. Fifth, the same vocabulary set of 100 signs was introduced to all participants. We did not use individually adjusted vocabularies for each participant, because of the nature of this study (an immersion approach). Also, as this was a KWS introduction program, we opted to choose a core vocabulary to serve a variety of communicative functions (whereas fringe vocabulary may restrict communicative functionality; Dodd & Gorey, 2014). In further stages of the KWS program, however, sign vocabularies should be individualized for each participant.

In conclusion, we developed and implemented a KWS program that was successful in teaching KWS to support staff and adults with mild to severe ID. The program proved to be an efficient method for teaching adults with ID new communication skills, and could be incorporated into similar service settings.

Chapter 7 General conclusions and directions for future research

7.1. Summary of research findings

In this research project, the functional use of key word signing (KWS) in adults with intellectual disability (ID) was evaluated. This was necessary because, despite the widespread use of KWS, its functionality in adults with ID has not been studied thoroughly. The majority of the literature concerning KWS focuses on the acquisition and recall of manual signs, and mostly involves children and adolescents. Also, little information is available concerning the prevalence of KWS use and the characteristics of adults with ID who use it. A first goal of this study was to explore this prevalence of KWS use among adults with ID in

Flanders. The next study goals were to relate the functional KWS use of adults with ID to three types of characteristics that have been found relevant to KWS: characteristics of the manual signs, client characteristics, and environmental characteristics. Four studies were set up to attain these goals. **First** a broad survey study was performed to evaluate the prevalence of KWS use among adults with ID in Flanders. In a **second** survey study, sign characteristics of the Flemish KWS system were related to the functional sign vocabulary of 119 adults with ID. Therefore, first, the phonological, iconic, and referential characteristics of the 507 basic signs of this system were determined. In the **third** study, a cross-sectional observation study, we examined the relation between client characteristics (cognition, language, and communication skills) and the functional KWS use of 40 adults with ID. A narrative task was developed to measure this functional KWS use in our participants. Their KWS use was also evaluated during conversation. The **fourth** and final study of this research project had a one group pretest-posttest intervention design. The relation between client (language and communication, motor, and imitation skills) and environmental (KWS use of support staff) characteristics and the functional KWS use of 15 adults with ID was evaluated qualitatively. In this study, a KWS program in which KWS was introduced to adults with ID through their support staff was developed and applied. Hereafter we describe the main findings of this research project.

7.1.1. Study 1. Prevalence of KWS

A combination of telephone and written surveys among all service providers for adults with ID in Flanders, showed that over half of them used KWS with one or more of their clients, and over 25% of their clients (= 1,902 individuals) used KWS actively. More than half of these KWS users had severe ID and more than a third had moderate ID, but KWS was also used in adults with a mild or profound ID. Nearly half of the participants only used 10 to 50 manual signs both receptively and expressively, although a small group was reported to know more than 200 signs. Sign knowledge was related to the degree of ID of the participants. Most adults with mild ID produced fewer than 10 signs but understood 50 to 200 signs, whereas the majority of the adults with moderate and severe ID produced and understood 10 to 50 signs. Most adults with profound ID produced and understood fewer than 10 signs. The majority of their support workers understood and produced fewer than 10 manual signs. Although the majority of the support workers had a positive attitude towards KWS, 25% of them had motivational problems and found it difficult to implement KWS in their daily work. Both the attitude of the support staff and their sign knowledge related to the sign knowledge of their clients. When staff had a positive attitude, and when staff had a larger manual sign vocabulary, their clients possessed a larger sign vocabulary as well.

7.1.2. Study 2. Sign characteristics and functional KWS use

The first step in the second study of this research project was to determine the sign characteristics of the Flemish KWS system *Spreken Met Ondersteuning van Gebaren* (SMOG, Speaking with support of signs). Phonologically, the SMOG corpus was found to display a large variety of hand shapes, movements, locations and orientations. Most of the SMOG signs (68%) were identical to their corresponding *Vlaamse Gebarentaal* (VGT, Flemish Sign Language) signs. For the remaining signs, mainly hand shapes were adapted. With regard to their iconicity, 22% of the signs were judged to be transparent (their meaning was guessed correctly by minimum 50% of the respondents) and 69% were judged to be translucent (minimum 50% of the respondents perceived the relation between the sign and its referent as clear). The referents of most signs were nouns and referred to concepts of hobby and free time. The mean concreteness of the signs (with 0% being abstract and 100% being concrete) was 65%. The number of signs used spontaneously in functional, everyday communication by 119 participating adults with ID, was evaluated using a questionnaire. Their mean productive functional sign vocabulary was 189 (of the 507) signs, and this related to their mental age (participants with a higher mental age possessed a larger sign vocabulary). This functional sign vocabulary consisted of fewer than 100 signs for 22 participants and of more than 300 signs for 17 participants. Relating the sign characteristics to the sign functionality (= the number of participants who used the sign in their functional vocabulary) revealed that semantic category and grammatical class contributed strongest to sign functionality. Signs referring to foods and drinks, and verbs, were most functional. Concreteness and translucency of the signs also contributed to sign functionality, but to a lesser extent. The influence of phonological sign characteristics on sign functionality was only minimal.

7.1.3. Study 3. Client characteristics and functional KWS use

The functional KWS use of the 40 adults with ID who participated in the cross-sectional observation study was measured with a narrative task and during conversation. In the narrative task, which was designed specifically for use in adults who use KWS, participants supported half of their utterances with manual signs, but rarely combined multiple signs in one utterance (average mean length of sign turn [MLST] of 1.15). The adults succeeded in using KWS to express a variety of narrative functions. During a 15-minute conversation, participants supported 30% of their utterances with manual signs, and mostly, signs weren't combined either (MLST of 1.07). The most used communicative functions were representation functions (giving information and naming) both for verbal language and manual signs. The narrative task was found to be a useful and valid evaluation tool for functional KWS use in adults with ID, because the narrative measures correlated significantly with the conversational KWS measures. These measures of functional KWS use were related to client characteristics in terms of cognition and language and communication. Cognition (mental age) as well as the results on language and communication tests all correlated significantly with the verbal language measures on the narrative task and during conversation, but no correlations with the manual sign measures were found.

7.1.4. Study 4. Client and environmental characteristics and functional KWS use

Fifteen adults with ID and their support workers participated in the fourth study of this research project. Measures of functional KWS use during a narrative task and during conversation, differed significantly before and after a 12-month introduction of KWS in the residence and day care centre of the participants. During the posttest narrative task, participants produced significantly more manual sign utterances, manual signs, and a larger diversity of signs compared with pretest measures. The same results were found during a 5-minute conversation. The participants also produced significantly more words after the intervention during the narrative task, but not during the conversation, and produced a larger variety of narrative communicative functions using KWS. The KWS use of support staff was also evaluated. Verbal measures did not differ significantly before and after the intervention, but manual sign measures did. Staff produced more sign utterances, more signs, and a larger sign diversity after the intervention. Client characteristics concerning cognition, language and communication, imitation, and motor skills were qualitatively related to their verbal and manual signing measures.

7.2. Positive aspects and pitfalls of KWS use in adults with ID

This research project focused on the functional use of KWS in adults with ID. This is the first project that studied KWS from different angles (taking into account sign, client, and environmental characteristics) and with a variety of research designs (both survey and observation studies, and both cross-sectional and intervention designs). The outcome of this project revealed some positive results. We found that KWS knowledge is available in over 50% of the residential and day care service providers in Flanders. Also, KWS is used with adults with all possible degrees of ID. We also found that adults with ID are capable of learning KWS through their support staff and can build up an extensive functional KWS vocabulary, and that they succeed in using KWS for a variety of communicative functions.

On the other hand, some obstacles concerning the use of KWS in adults with ID became apparent in this research project. A first group of issues is related to the specific **KWS system** that is used in Flanders. Many Flemish residential and day care service providers for adults with ID had a lack of knowledge of KWS. They reported to be unaware of the existence of KWS, of the methodology, or of the possible target population. Clearly, the idea is not that every adult with ID should use KWS, but everyone should be able to use KWS if this would be the preferred means of augmentative and alternative communication (AAC). Some service providers stated that they were interested in using KWS, but that none of their staff knew the signs of the Flemish KWS system, and that they could not find any resources concerning this system. This points out that, although a SMOG secretary exists in Flanders and a SMOG manual has been written, these do not seem to be able to fulfil the demands that are present among service providers for adults with ID. Information regarding SMOG seems difficult to access for certain professionals. Also, the need for more resources, particularly aimed at adults with ID and involving the manual signs themselves, is high. The SMOG signs are only visualised using line drawings, and these line drawings are only available to professionals who participate in an official SMOG training (Loncke, Nijs, & Smet., 1998). Other resources are necessary in order to give people access to the communication means they need, while still maintaining the standardization of the manual signs.

A second issue apparent from this research project is the lack of suitable **evaluation methods** for the language abilities of adult KWS users with ID. We found that existing standard language and communication tests can seriously underestimate the capabilities of adults with ID who use KWS. These tests do not take into account the KWS skills of these adults. When their verbal language is very limited, but they can express themselves on a higher language level using KWS, they nevertheless obtain low scores on most language tests. An evaluation instrument for KWS use in adults with ID that is useable in clinical practice, is needed.

A third group of problems relates to **the way KWS is used with and by adults with ID**. Although KWS is used with adults with all degrees of ID in Flanders, many providers did however report not to consider using KWS with their clients because of personal characteristics of these clients (for example cognitive or motor skills). This reflects that many professionals still think that KWS interventions demand certain prerequisites of their clients. This misconception should be cleared up. Many adults with ID also do not get access to a KWS intervention because of the lack of time and/or money (staff) of many service providers to teach KWS to their clients. This was apparent in the fact that smaller service providers more frequently did not use KWS with any of their clients. Also, when no speech-language pathologist (SLP) is present, chances that KWS is used are much smaller. This indicates that different methods are warranted to introduce KWS in a residence or day care centre for adults with ID.

Issues with regard to the **KWS training of support staff** form a fourth and final group of problems. A lack of sign knowledge was apparent in the sign vocabulary of many support workers who participated in our research project. Their sign vocabulary was often smaller than that of their clients. Some support workers only used very few to no signs during functional communication. This restricted functional use of KWS of many support staff can be related to problems of acquisition, maintenance, and/or application of KWS. Acquisition problems were clear in those service providers that did not teach KWS to their staff, but did have clients who used it. This is very worrying and reveals a serious lack of knowledge about the KWS methodology and how KWS is introduced in residences or day care centres for adults with ID. Support staff that did acquire a set of manual signs, often did not succeed in learning to simplify the verbal language they produced when using KWS. They continued to use complex utterances instead of adapting their language to become more clear and simple. Maintenance problems could also have caused the lack of KWS use of certain support staff, because some service providers reported to have abandoned the use of KWS due to a diminished interest and effort of their support staff. This is also apparent from the motivational problems that support workers often reported to experience. Application problems, finally, were probably also present in the support workers that participated in this research project. Some support workers possibly possessed a sufficient sign vocabulary, but did not succeed in applying this vocabulary in functional communication. This could be related to motivational issues as well, besides to other personal characteristics of support staff (for example feelings of embarrassment to use manual signs) or external circumstances (for example no appreciation of their efforts to use KWS by their superiors). We suspect that the quality of interaction between adults with ID and their support staff might also be improved, although this was not formally evaluated in this research project.

In conclusion, both positive results and pitfalls regarding KWS became apparent in this research project. KWS certainly proved to be a valuable and useful means of AAC for adults with ID. On the other hand, we believe that there is room for improvement. With this research project, we wanted to weigh the advantages and disadvantages of different options for amelioration. This allows us to formulate action points and suggestions on how the pitfalls could be addressed and how KWS could be more successfully applied in adults with ID.

In the following four paragraphs, first we will address the question which KWS system could best be used in adults with ID (7.3). Subsequent, teaching KWS to and using KWS with those adults with ID (7.4) are discussed. Next we address methods to evaluate functional KWS use in this population (7.5). Furthermore, KWS training of support staff is discussed (7.6). Hereafter we offer suggestions for future research (7.7) and complete this chapter with a brief conclusion (7.8).

7.3. Which KWS system to use with adults with ID?

Many issues that were present in this research project, arose from the specific KWS system that was used. This KWS system, SMOG, is the system that nowadays is the most frequently used system in Flanders. It certainly has proved its value and has helped hundreds of individuals with communication problems in the last decennia. On the other hand, we experienced quite some frustrations and problems with the organization and application of SMOG among service providers for adults with ID in Flanders. A key issue was the fact that SMOG was perceived as being inaccessible (Paelinck, 2002) and that few to no resources are available with regard to the SMOG signs. We think that these issues could and should be addressed, while still retaining the positive aspects of SMOG.

SMOG is a **KWS system with a restricted vocabulary and motorically adapted manual signs**. Although all KWS systems have an open-ended vocabulary in theory (signs can always be added), in practice, some systems such as SMOG only offer a limited set of signs. SMOG has a basic vocabulary of about 500 manual signs. Obtaining manual signs for additional concepts is not straight-forward (professionals need to contact the SMOG office and motivate the need for additional signs). The authors of SMOG believe that a restricted vocabulary has advantages for people with ID (Loncke et al., 1998). Grove and Walker (1990), too, argue that individuals with ID might benefit from an initial sign lexicon that is limited in size, because they might have problems with processing, retention and recall of information. A limited initial lexicon needs to be simple to learn and immediately useful. By using manual signs that cover broader concepts, a small set of signs can nevertheless be very applicable. Offering a too large diversity of manual signs to a person with ID, might cause confusion and memory overload. On the other hand, as suggested by Grove and Walker, the lexicon of a KWS user should be broadened as the persons' competence increases, and the use of additional vocabulary is recommended. For some individuals these limited vocabulary sets will be sufficient, but for others, signs for important concepts will lack. Mein and O'Connor (1960, in Grove & Walker, 1990) found that adults with a severe ID possessed a core vocabulary of 350 words, and a total vocabulary of about 2,400 words. KWS users should be able to use their means of AAC not only for a small selection of their expressive or receptive vocabulary, but also when using fringe vocabulary in different situations. If they do not receive access to the symbols they need to express themselves, they will be impeded in their communication (Grove & Walker, 1990). KWS users, both those with ID and their communication partners without ID, should be able to use KWS in a variety of settings, to express a large number of communicative functions, and to display creativity and playfulness using KWS. Therefore, an open-ended and flexible lexicon is needed, which can be adapted to the characteristics of the individual KWS user and can be extended as the KWS user evolves (Grove & Walker, 1990).

SMOG also is a KWS system which uses manual signs that are adapted to make them motorically easier to perform. The signs that are used in SMOG were taken from VGT, and the most changed feature is the hand shape of the signs. Another KWS system with adapted signs is for example Simplified Signs, that was developed in the United States (Bonvillian et al., 2008). This sign system consists of 1,000 highly iconic and motorically simple signs, derived or adapted from many different sign languages. The authors of SMOG and Simplified Signs state that they have experienced that signs from sign languages are too complex for many KWS users. For certain individuals, indeed, it might be necessary to motorically adapt signs. People with a hemiparesis for example cannot perform two-handed signs. Also, as suggested by Bonvillian et al. (2008), the application of a simplified system can have advantages not only for individuals with motor difficulties, but also for the environment of people with communication problems. Perhaps signs that are easier to produce and/or remember, would increase the signing proficiency of the communication partners of people with disabilities and thus also positively influence the KWS use of the latter. On the other hand, the sign knowledge and KWS use of support staff that participated in this research project, although they used a KWS system with motorically adapted signs (SMOG), still falls far short of requirements. Also, as described in section 7.2, the lack of KWS use in support staff is probably not predominantly related to acquisition difficulties, but rather to maintenance and application problems. Those problems seem less related to the specific characteristics of the manual signs that are used.

These sign characteristics, as evident from this research project, did not seem to be the key issue with regard to functional KWS use in adults with ID. We related different phonological, iconic, and referential sign characteristics of the Flemish KWS system SMOG to the functional use of KWS in our participants. We found that mainly referential characteristics (semantic category, grammatical class, and concreteness of the signs) were of influence on KWS use, with the translucency of the signs also playing a part. We did not find a relation between sign phonology and functionality. Of course, sign functionality is not the first step when applying a KWS system, and signs need to be acquired and remembered before they can be used. With regard to this sign acquisition and recall, many studies did find some phonological and iconic sign characteristics to be of influence (see chapter 4). Analogous to spoken language development, children who learn sign language will apply phonological processes and simplify the signs they perceive. This, however, does not mean that it is necessary for the environment to offer simplified signs in order for the children to learn them (Hubbers, 2009). This analogy does raise the question whether specially developed signs or manual signs from the local sign language should best be used in KWS systems for individuals with ID.

As described in the introduction, in most countries, **signs from the local sign language**, without any motor adaptations, are in fact used with a KWS approach in both children and adults with ID. Using these signs from sign languages has many advantages. First of all, sign languages do not have a restricted vocabulary and can even offer a quasi-limitless vocabulary. Also, signs are not only available for core vocabulary concepts, but also for very specific fringe vocabulary, which might be highly relevant to a specific KWS user. This way, it is much easier for each individual KWS user to access the vocabulary he or she needs. KWS users are not limited to existing lists of concepts, but can develop a vocabulary that is personally adapted to his or her social environment and that keeps evolving with changes in that social environment. Also, when KWS is used with young children with ID, it is often not yet clear which degree of ID and which impairments and strengths the child possesses. By using an unrestricted KWS system, the child will not be limited in his or her development when, for example because of severe speech intelligibility problems, he or she will continue to depend on KWS throughout the language developmental period, but only has a mild or moderate ID and thus is capable of learning an extensive vocabulary. New signs can than easily be looked up in existing sign dictionaries. These dictionaries are a second advantage of using signs from sign languages: most sign languages nowadays are very well documented and some are standardized or in the process towards standardization (e.g., *Nederlandse Gebarentaal,* NGT [Dutch Sign Language], and VGT). Most sign languages are documented with a combination of different methods, such as *SignWriting* (Sutton, 2009), pictures, line drawings, and video clips. In these times in which the internet provides a wealth of information, there are a lot of opportunities to spread resources for sign learning. The combination of many resources and the distribution of these resources through the internet, ensure a better standardization of signs. Because signs are three-dimensional (visual-spatial production modality), it is easier to learn signs from video material compared with line drawings, which can cause misunderstandings. Video clips allow learners to view the sign's hand shapes, location, movement, and orientation and to play back the sign multiple times in slow motion, allowing the learner to study all aspects of the sign in detail. Many KWS programs prescribe and organize trainings. One of the most efficient methods for learning manual signs is, indeed, learning them from an experienced signer. KWS also involves much more than just using manual signs (see section 1.3.1), and the KWS methodology can best be learned and practiced in a training situation as well. In practice, however, many people wish and should be able to start using KWS immediately. Trainings may have waiting lists, may be too expensive, or may be located too far away for some. Those people will look for resources and, if only line drawings are available (for example for SMOG), use them as a source for learning signs, possibly causing errors. Furthermore, it is impossible to teach "all" signs in a KWS training. Even when a system with a restricted vocabulary such as SMOG is used, professionals cannot teach all signs to parents or support staff. Parents and support staff also should not rely on others to access manual signs when they feel those signs are needed. Because parents and support workers usually know their children or clients very well, they often have the best knowledge of the social environment of their children or clients, and are in the best position to detect needs for additional vocabulary. Sign dictionaries and other resources should thus be freely available to any person who wants to use KWS (Grove & Walker, 1990). In Flanders, the VGT lexicon is very well documented, and freely accessible through an online dictionary (*Woordenboek Vlaamse Gebarentaal* [Flemish Sign Language dictionary], 2004). For most sign languages (such as VGT, NGT, American Sign Language [ASL], and British Sign Language [BSL]) many other resources, besides dictionaries, are available as well (books, games, websites, DVDs, and so on), of which many can also be used with a KWS approach. A third advantage of the use of signs from sign languages is that the group of people with whom KWS users can communicate, is extended to people with hearing impairments and others who know sign language.

Considering all advantages and disadvantages of the different systems that we described, the question remains what type of KWS system is ideal for adults with ID: a restricted system with adapted signs, or a system that uses signs from the local sign language? The choice of "the best" KWS system is a difficult issue, and we think that it is impossible to state a general truth. We have engaged in many discussions with the authors of SMOG (L. Smet, personal communication, January 2010), with sign language professionals (B. Hanegreefs, personal communication, March 23, 2011 and T. Schermer, personal communication, June 3, 2010), and with KWS professionals from all over the world (e.g., Australia: K. Bloomberg and H. Johnson, personal communication, August 3, 2012; the Netherlands: A. Hubbers and W. Scheres, personal communication, June 3, 2010; Germany: A. Bober, personal communication, May 20, 2014) in an effort to gain a nuanced impression of this issue. The majority of these professionals are convinced that the creation of a separate sign system for people with intellectual disabilities is not necessary, and that the use of conventional signs from local sign languages entails more advantages than disadvantages.

Taking into account all the information available to us, however, it seems as if the main issue actually is not which precise signs are being used, but that those signs that are needed for an individual, are readily accessible to him or her and his/her environment. In practice, we believe that this aim could best be achieved when signs from VGT would be used in Flanders with a KWS approach. The signs from VGT are readily accessible, very well documented, and are parts of a language that is used by a large group of individuals (about 13,000 individuals with and without hearing impairments use VGT in Flanders, Fevlado, 2014). This does not mean that we suggest the termination of SMOG! The strengths of SMOG should certainly be retained, but the weaknesses could be addressed by the use of VGT signs. As discussed, the use of a restricted vocabulary can have advantages for some individuals with ID. Similar to Makaton (Grove & Walker, 1990), SMOG could keep offering the basic sign corpus as an initial corpus to start from. This basic corpus has indeed been developed to cover the basic communication needs for emerging communicators. There should, however, be a possibility to easily extend this sign corpus when necessary. Makaton for example offers different vocabulary stages, and gradually, more and more fringe vocabulary is included in these stages (Grove & Walker, 2005). Different resources should be developed, for example similar to those available for Makaton and Key Word Sign Australia (KWSA; Bloomberg, 2005), in which additional vocabulary is incorporated. KWSA offers a book that covers vocabulary regarding Australian football (*Key Word Sign Footy Book*; Keesing, Basterfield, & Ryan, 2010), and Makaton offers materials that zoom in on sex education, and plants and trees, for example (The Makaton Charity, 2014). These resources should not only be directed towards children, but towards adults as well. Some of them could be developed in cooperation with the *Vlaamse Gebarentaalcentrum* (Centre for Flemish Sign Language), because, with regard to dictionaries and vocabulary resources, these could be useful for both sign language and KWS users.

Many readers will probably still be concerned about the psychomotor characteristics of the VGT signs. Won't these signs be too difficult for many individuals with ID after all? And how would this transition between SMOG and VGT take place? We understand these concerns but believe they should not be predominant. Of course, some manual signs from VGT will be too difficult for some individuals with ID. Also, some SMOG signs are too difficult for some individuals with ID. Let us examine the example of a man with ID and a hemiparesis in more detail. This man can only produce one-handed signs. It might be necessary to adapt some signs specifically for him. For example, the sign for CHEESE is two-handed (both in SMOG and in VGT, see Figure 1.2) and will have to be made with one hand. Probably, the man himself will spontaneously adapt the sign. If he does not succeed in doing this, we might have to support him by modelling how he could produce the sign, or by physically supporting his hand and arm. This does not mean, however, that we will ourselves only use one arm when using KWS towards our client. Similar to parents who do not apply phonological processes themselves when they talk to their young children, communication partners who use KWS towards persons with motor difficulties do not necessarily need to adjust the signs they produce themselves. When these persons experience difficulties in adapting the signs, they of course should be assisted in doing so. This would be necessary when VGT signs would be used, but with SMOG signs, the same issue already exists. This implies that SMOG signs as well as VGT signs can be used in individuals with motor difficulties. Also, the signs of SMOG have been adapted, but do not seem much simpler compared to sign language signs iconically (similar to ASL iconicity rates) or phonologically. An evaluation of the corresponding VGT signs did reveal that 68% of the SMOG signs are identical to VGT signs. The transition from SMOG to VGT signs would thus not entail such a huge change. Within VGT, different dialects exist, and it would still be a good idea to choose the most iconic signs from these dialects and to agree upon the use of these signs among KWS users. This means that SMOG should still exist, not as a restricted sign system, but as a KWS approach which uses signs from VGT. The same procedure has been carried out in the Netherlands, where the separate *Weerklank* signs are not used anymore, but the *Weerklank* methodology has been retained while signs are borrowed from NGT (Hubbers, 2009). At the moment, a transition period is in effect. Some people still use the “old” *Weerklank* signs, but young children are all taught the standardized NGT signs. We also suggest to gradually change the manual signs used with a KWS approach in Flanders from SMOG signs to VGT signs. SMOG signs should not be perceived as "wrong", but VGT signs should be taught to new KWS learners. This means that for a small percentage of signs, two different executions would be in use during this transition period. Clinical experience from the Netherlands shows that most individuals do not experience this as a big problem (Hubbers, 2009). In Germany as well, many people are convinced that it is not necessary to develop signs specifically for people with ID, and have started using signs from the local sign language (*Deutsche Gebärdensprache* [DGS], German Sign Language) with individuals with ID (Braun, 2000; Bober, 1994, 1995, 1996). This means that in some German residences or day care centres for adults with ID, different sign systems are used with different clients (DGS signs with some, and for example signs from *Schau doch meine Hände an* [Look at my hands] with others). Professionals in Germany also experience few problems with these multiple executions of some signs. As A. Bober, psychologist for individuals with ID, pointed out:

"Das Analogon zur Lautsprache wäre, wenn man sagt: Also wir sagen jetzt alle nur noch Sofa (nicht Couch) und nur noch Geldbörse (nicht Portmonee) und nur noch Orange (nicht Apfelsine). … Das macht man ja auch nicht." [The analogy in verbal language would be to say: From now on we will only use the word sofa (not couch), only purse (not wallet) and only orange (not "Apfelsine", a German synonym for orange). Yet we do not do that.] (Personal communication, May 20th, 2014).

When those sign systems that are being used, are also well documented and easily accessible, this will help to maintain a good standardization of the signs and ensure that all individuals, whatever signs they use, can use their KWS system to the fullest.

7.4. Methods to evaluate KWS use in adults with ID

The main focus of this research project was the functional KWS use of adults with ID. One of our first challenges was to find a valid, reliable, and efficient method for the evaluation of this functional use of KWS. No existing evaluation methods were found, so the need for new evaluation methods for KWS use was evident.

As a first step, we developed questionnaires. The use of **questionnaires** to gather data has advantages, but also implies some disadvantages or pitfalls. A questionnaire is the method of choice when large(r) groups of individuals are evaluated, and taps into the experience of caregivers and other respondents that are very familiar with the individual. Many participants can be reached with minimal resources, and a wealth of information can be collected. Most standardized test instruments that evaluate everyday behaviour of people, consist of questionnaires (e.g., the *Vineland Adaptive Behavior Scales*, Sparrow, Balla, & Chicchetti, 2005; and the *N-CDIs*, Zink & Lejaegere, 2002). On the other hand, the use of questionnaires involves a number of risks (Dillman, Smyth, & Christian, 2009). A first risk is contained in the questions that are asked. The wording and type (e.g., open- or close-ended questions) of questions can influence the responses on those questions (Totten, Panacek, & Price, 1999). People also tend to answer socially desirably (Murray, 1999) and can have a hard time estimating their own or other people's behaviour (Bradburn, Rips, & Shevell, 1987). Self-report data imply some validity risks, because people can over- or underestimate their observations or may be influenced by their momentary feelings when answering questions (Dillman et al., 2009). Questionnaires also require quite some time from the respondent to be filled out. In addition, the data need to be processed, which also requires time. Clinically, this can be an issue. Despite these pitfalls, we chose to use questionnaires in this research project. By thoroughly evaluating the questionnaires in experienced panels, and by pilot testing them, we tried to avoid the major pitfalls of questionnaire design. The first questionnaire was broad and directed at communication professionals working in residences and day care centres for adults with ID. This questionnaire aimed at giving an overview of the prevalence of KWS use in Flanders. Clinically, this questionnaire might not be very relevant. The second questionnaire was directed at the support staff of individual KWS users. It consisted of a list of the basic signs of SMOG, on which support staff could indicate which signs were being used by the KWS user. This second questionnaire might be useful in practice. On the other hand, its psychometric properties have not been evaluated thoroughly. Participating respondents also indicated that filling out the questionnaire took a lot of time. Processing and interpreting the results of the questionnaire took quite some time as well. Therefore, we think that an instrument in which the KWS use of the clients is observed, would be more suitable for clinical practice.

Because no instrument for the evaluation of the functional KWS use of adults with ID existed, we had to develop a new instrument. Evaluating this functional KWS use seemed like an imposing task. Functional use of KWS refers to the way adults with ID use it in their daily communication, with their usual interlocutors, and in their familiar environment, so the ideal manner to evaluate this KWS functionality would be to observe an adult KWS user 24/7, while oneself being invisible to the adult. Such a daunting job requires a lot of time, implies many practical issues, and is not feasible in a large research project. Therefore, we needed to develop alternative methods. Inspired by Abbeduto, Benson, Short, & Dolish (1995), we combined a **conversation language sample** and a **narrative task**. Abbeduto et al. (1995, p. 286) stated that: *"a comprehensive evaluation of the expressive language skills of individuals with mental retardation will require the analysis of language samples obtained in both [= narrative and conversational] contexts"*. The advantages of a conversation are that a high rate of language can be obtained, in a very natural, unconstrained situation. Narratives, however, have been found to elicit more syntactically complex language and might give a better view of the grammatical skills of the participants (Abbeduto et al., 1995). Clinically as well, narrative tasks are better useful because they only take a few minutes, and the results are processed much faster compared to those of a conversation language sample. They also offer a more standardized procedure and language generation in a more stable context. We developed a narrative task specifically for adults with ID who use KWS. This task proved to be a valid measure of the functional KWS skills of our participants. The KWS measures on the narrative task related significantly to those during conversation, indicating that our narrative task gives a good account of functional KWS use. The verbal measures also related significantly to the results of standard language and communication tests, whereas the sign measures did not. Manual signing skills are rarely addressed in standardized language and communication tests, so this can explain the absence of a relationship. This also indicates that other means of communication besides verbal language should be evaluated and taken into account in the diagnostic process of people with ID, and that many standardized language and communication tests fail in doing so. The developed narrative task could fill up part of this gap. The inter-rater reliability of our task was very high. Furthermore, the task was sensitive enough to detect differences in KWS skills before and after a KWS intervention. Finally, the task lasted no more than 5 minutes, and was perceived as an enjoyable task by the adults with ID. These findings suggest that the narrative task could be useful clinically to evaluate the functional KWS use of adults with ID. We do suggest that the psychometric properties of the narrative task (for example test-retest reliability) should be further explored and, if these properties seem sufficient, that normative data should be gathered (see section 7.7). As a reference, percentiles of the narratives for the 40 participating KWS users are added in Appendix L.

7.5. The use of KWS in adults with ID

The KWS users that were identified in this research project, were adults with all possible degrees of ID. They often had additional disabilities as well, such as motor and behaviour difficulties. Many service providers however reported to exclude clients from using KWS based on certain prerequisites, mainly related to cognitive, language and communication, motor, and imitation skills. We, too, nearly made this mistake. The initial intent of this research project indeed was to develop a test instrument that would help in selecting clients for a KWS intervention. We quickly abandoned this research goal when we realized that such a test instrument could exclude people, who would and could possibly benefit from a KWS intervention, from essential support in their communication. All adults with ID who experience a communication problem and who are capable of understanding and/or producing manual signs, can possibly benefit from a KWS approach. We did find a large variety in functional KWS use in our participants, and these varieties could be related to client characteristics and characteristics of the evaluation methods that we used (see section 7.4).

A first client characteristic that we studied, was the **cognition** of KWS users. In the first survey study, KWS users with mild, moderate, severe, and profound ID were identified. Most of them only used 10 to 50 signs. All adults that used KWS and made use of the participating service providers, even if they only used a few signs, were included in this questionnaire, which might explain this seemingly low figure. The number of signs used by the KWS user correlated significantly with his or her degree of ID. Most adults with mild ID understood 50 to 200 signs, but only produced fewer than 10 signs. The majority of adults with mild ID, indeed, possess spoken language and thus might not rely that strongly on KWS for language production. The adults with profound ID that were identified in this survey study, predominantly used fewer than 10 signs. Many individuals with profound ID communicate on a presymbolic level (Bloomberg, 2005; Hubbers, 2009; Romski & Sevcik, 1997), and thus use the manual signs as signals as opposed to symbols. The largest group of KWS users had a moderate to severe ID. Most of them used 10 to 50 signs, but some of them possessed an expressive sign vocabulary of over 200 signs. This indicates that adults with moderate to severe ID seem capable of learning to use a large number of signs communicatively. The 119 KWS users for whom the second questionnaire was filled out, predominantly had a moderate ID ($M_{\text{mental age}}$ = 50 months). We excluded KWS users who only used 10 signs or fewer, because we wanted to focus on adults who used KWS symbolically, and as their main means of communication. In the first survey, all KWS users in the questioned services were included, but the second survey was filled out for more proficient KWS users, as selected by their SLP or support staff. The 119 included adults had a mean functional expressive sign vocabulary of 189 signs, with adults with a higher mental age, possessing of a larger sign vocabulary. This figure of 189 signs is quite different to the 10 to 50 signs that most adults of the first study were reported to use, and shows that, regarding the size of the 119 adults' functional sign vocabulary, they were situated in the upper segment of the broad group of Flemish KWS users. The functional KWS use of 40 of these 119 adults with ID was examined cross-sectional through observation, in a narrative task and during conversation. Their mean mental age was comparable to that of the larger group ($M_{\text{mental age}}$ = 58 months), but in this study, the mental age of the participants did not relate significantly to their KWS use. So, although mental age was related to the size of the reported functional sign vocabularies in the questionnaire study, when functional KWS use was observed in a narrative task or conversation, it did not relate to the mental age of the participants. We could interpret this as if, despite the fact that mental age is related to the size of the sign vocabulary of an adult with ID, the capability of an adult with ID to learn to use KWS functionally, is independent of his or her degree of ID. This would support the notion that no prerequisites in terms of cognition should be made for adults with ID to be taught KWS. On the other hand, this might also indicate that the cognitive skills of adults with ID who have communication problems and use KWS, might be underestimated when using classic IQ tests. Our findings support the advocacy for a combination of different behavioural measures when evaluating the intelligence of adults with ID, and emphasize the importance of acknowledging any means of communication is used.

In the 15 participants of the intervention study **motor and imitation skills** were evaluated as well. Motor skills seemed to relate with manual sign measures but only during narratives, and imitation skills did not seem related with any manual sign measures. These findings, too, support the conviction that no individuals should be excluded from KWS interventions, even if they do not show a high proficiency in motor and imitation skills. On the other hand, motor skills did seem to be relevant to manual sign use on the narrative task. Possibly, the manual signs that were offered in this task were motorically more difficult than those that were produced spontaneously during the conversations. Also, the participants had only been using KWS for a period of 12 months. Because phonological characteristics of manual signs have been found to influence sign acquisition, it is possible that these influences still were in force in our group of participants.

We observed the functional KWS use of the 40 participating KWS users (cross-sectional group) and the 15 adults with ID (intervention group) using similar measures. The same narrative task was used, and a similar conversation language sample was collected. Comparing the results of these two groups of KWS users (the cross-sectional group with the posttest results of the intervention group) reveals some interesting results. The results on the narrative task of the groups are quite different. Both groups produced a mean of 24 utterances, but the cross-sectional group used more manual sign utterances, more manual signs and fewer words compared with the intervention group, which seemed to be a more verbal group. Their average mean length of utterance (MLU, 3.86) was also higher than that of the cross-sectional group (2.37). Of course, the intervention group only had been using KWS for 12 months, whereas many of the clients in the cross-sectional group were using KWS for a much longer period. The clients in the cross-sectional group also were all adults for whom KWS was a successful, and their preferred means of AAC. All clients in the intervention group experienced communication difficulties before the intervention started, but for some of them, KWS did not seem to be the pre-eminent means of AAC. Some of them did not use any or very few manual signs during the posttest narrative task. Another interesting finding when comparing the KWS use of the cross-sectional group with that of the intervention group, is that both groups produced a mean MLST of a little over 1. They both produced a longer MLST in the narrative task (1.15 for the cross-sectional group and 1.12 for the intervention group) compared with the conversation (1.07 and 1.01 for the cross-sectional and intervention group, respectively), so the narrative task does seem to evoke grammatically more complex utterances (as suggested by Abbeduto et al., 1995). What is striking, is that no apparent difference in MLST was found before and after the intervention, and between the two groups. This suggests that, even for clients who have been using KWS for an extended period of time, most utterances still consist of only one sign. Grove and Dockrell (2000) found that the MLST of children rarely evolved beyond 2.0 to 2.5. For adults with ID, research has not yet revealed to what level of expressive KWS use they can evolve. Grove and Dockrell did suggest that KWS users can evolve grammatically by adding features to the signs they use, such as sign modifications, the use of classifiers, and so on. This might allow them to evolve grammatically, but, because these sign modifications do not influence the MLST, they cannot be detected using this measure. On the other hand, one might wonder if KWS users can evolve beyond the two-sign combination stage, if their communication partners rarely, if ever, model this use of sign combinations (see section 7.6). Also, in the light of McNeill's theory on gesture use (1992), we might wonder if the goal for KWS users should be to evolve towards use longer combinations of signs. If KWS can be considered as a gestural system, as we proposed in 1.3.4, it is sufficient to support the main content words of a sentence with a sign, an trying to support more spoken words with signs, would possibly undermine the psycholinguistic feasibility of KWS. Most utterances of the participating clients (77% of the narratives of the observation study group to 97% of the narratives of the intervention study group) indeed were simultaneous utterances (speech and manual signs combined), indicating the relevance of McNeill's theory for this population as well.

The measures on the conversations are also quite different between both groups. Of course, the conversations themselves were different in design, explaining the majority of this distinction. The conversation of the observation group lasted 15 minutes, was held with an unknown communication partner who used KWS to a very high degree, and included materials such as a doll house and figurines. The conversation of the intervention group lasted only 5 minutes, and was held with a familiar communication partner who did not always use KWS. This can explain why the cross-sectional group used a larger variety of signs and supported a larger proportion of their utterances with manual signs. The mean MLU during conversation, however, was almost identical in both groups (2.76 in the cross-sectional group and 2.75 in the intervention group). So although the intervention group seemed to be a more verbal group during the narrative task, the complexity of their spoken language diminished during the conversation. The opposite was true in the cross-sectional group, which produced longer verbal utterances during conversation. Possibly, this can be related to the conversation style of the communication partners. The cross-sectional group held a conversation with an SLP who was very proficient in KWS, but the intervention group conversed with their support workers. The SLP paid a lot of attention to leaving room for the adult with ID to introduce topics and for him or her to take the lead in the conversation. The conversation style of the support workers was often perceived as more directive and dominant. This will be further discussed in section 7.6.

Although results showed that the KWS skills of the intervention group were not (yet) similar to those of the cross-sectional group after a 12 month intervention, they did show that the 15 participants had learned to use KWS functionally. This result is very promising towards service providers who have problems teaching KWS to their clients. Because we wanted to address the often mentioned lack of staff or time to teach KWS to adults with ID, we developed a KWS introduction program in which KWS was introduced through the support staff with a “sign of the week” approach. This program was successful in teaching KWS to the participating support staff and their clients (also see section 7.6). This proves that many adults with ID are capable of learning a new AAC method, even at a later age (our oldest participant was 74 years of age), and even without individual speech and language therapy. Lack of an SLP and lack of time should thus not be an excuse to deny people proper communication support. Of course, service providers do need support when they want to apply this KWS program. This could be a task for a central KWS office or, more broadly, for an AAC or communication support office. Unfortunately, for such offices as well, lack of time and money is a reality. On the other hand, we do feel that the money that a government would invest in the appointment of a team of communication support coaches for adults with ID that would operate nationwide, across service providers, would be very well spend. This certainly is the case because, as we perceived in practice, many SLPs who work with adults with ID in residences and day care centres still seem to devote most of their time on individual therapy with their clients in the therapy room. Instead, SLPs who work with adults with ID in these settings, should move their focus towards a coaching role and towards a more functional communication training in cooperation with support staff, caregivers, and other professionals.

7.6. KWS training of support staff of adults with ID

A key issue in the success or failure of a KWS intervention, as apparent from this research project, is the involvement of the environment of the KWS user. KWS stands or falls with the communication that is offered by the environment. This environment, in adults with ID who make use of residential and day care services, usually consists for a large part of support workers. The lack of KWS use by support staff that became clear in this research project, is an important obstacle and efforts should be made to reduce this problem. We found that the KWS use of support staff has a large influence on that of their clients. Adults with ID, indeed, need a competent language model in order to successfully learn

KWS and to be able to evolve in using it. Therefore, attention should be paid to the acquisition, maintenance, and application of KWS by support staff (Bryen & McGinley, 1991).

With regard to the **acquisition** of KWS, a first issue is the fact that some service providers have clients who use KWS, but cannot offer them support because none of their support workers know KWS. This problem might be related to the transition from school to adult services. Hamm and Mirenda (2006) reported that this transition might involve some problems for people with ID who use AAC. Most of them received a high degree of guidance during their school years, and suddenly receive less support when they relocate to a residential service or when their daily activity changes to attending a day care centre. For AAC in general and for KWS in particular, it is very important that the environment continues to offer the support necessary to each AAC user, and this is only possible if the same knowledge concerning these means of AAC is available in the adult services. This issue, again, can be related to the specific problem of accessibility of the Flemish KWS system SMOG (see section 7.3) and could be resolved if SMOG resources became more readily available. The lack of KWS knowledge of support staff might also be related to the fact that many services for adults with ID experience difficulties in successfully implementing KWS in their facilities. This prompted us to include an intervention study in this research project. We developed a KWS program to introduce KWS in a residential and day care facility through support staff. This KWS program (see chapter 6) consisted of workshops and a "sign of the week" approach, and was found to be successful in teaching KWS to both support staff and their clients. In the workshops, besides classical techniques of modelling and imitation, role play and video feedback techniques were applied as well. The relevance of role play, and the use of spontaneous communication, when practicing KWS, can be related to the gesture theory of McNeill (1992). When only prescribed sentences are used to practice KWS, participants still need to convert spoken language into signs (requiring more cognitive computational time) instead of starting from an idea and simultaneously producing speech and signs (which can be acquired through role play). Video feedback has previously been found to be a successful method in communication training for support staff of adults with ID (Damen, Kef, Worm, Janssen, & Schuengel, 2011; Dobson, Upadhyaya, &

Stanley, 2002; Koski, Martikainen, Burakoff, & Launonen, 2010; Purcell, McConkey, & Morris, 2000). The participating support workers used significantly more manual signs after the intervention. This positive result suggests that it is possible to teach support workers to use KWS during functional communication in a 12-month intervention program. The verbal language of the support staff, however, remained quite similar to that used before the intervention. This seems a surprising result. After all, research has shown that KWS helps the communication partner to slow down his or her speech rate and use an easier vocabulary and simpler sentences (Windsor & Fristoe, 1989, 1991). This should ensure that the spoken language of the communication partner is better in tune with the receptive skills of the adult with ID, what is often found to be a risk (Bartlett & Bunning, 1997; Bryen & McGinley, 1991). Surprisingly, support staff in our study did not seem to develop a simpler spoken language. Their complex verbal utterances that were often not supported by manual signs negatively influenced the manual sign initiatives of their clients. Indeed, the majority (85%) of utterances of support staff was not supported with a manual sign. Also, even though they did produce significantly more manual signs after the intervention, support staff still only produced a mean of 15 signs and 14 sign utterances during a 5-minute period, indicating that sign combinations were rarely present. Similar findings have been reported in literature. Bryen and McGinley (1991) found that, despite training in KWS, many support workers still predominantly used speech as input modality with KWS users and/or rarely supported their speech with manual signs. Grove (1995, in Smith & Grove, 2003) found that teachers tended to use complex spoken sentences with only sporadic use of signs when communicating to their KWS using pupils. This overreliance on verbal language of support staff has often been reported, not only when using KWS but in the communication between support staff and their adult clients with ID in general (Bartlett & Bunning, 1997; Bradshaw, 2001; Dobson et al., 2002; Healy & Walsh, 2007; McConkey, Morris, & Purcell, 1999; Purcell et al., 2000). So, although the results of our intervention study are positive in terms of the ability of support staff to learn KWS, to teach it to their clients, and to successfully apply it in functional communication, they also show that they still overly relied on verbal language. This verbal language should possibly have received more attention in the KWS training. Also, the KWS skills of our participating support workers might not have been fully developed after an intervention of 12 months. It is possible that more training is needed in order for the support staff to become truly proficient in their KWS use. The sign vocabulary of 100 signs, that were taught to the support staff in our study, might have also been too small to allow a spontaneous and smooth communication with KWS. We can imagine that it is difficult to support a spontaneous conversation with KWS, if only signs for a few concepts are known. Therefore, we suggest to teach a larger corpus of manual signs to all support staff who use KWS. This does require a larger effort of support staff as well. Perhaps, support staff could already be offered the opportunity to learn a set of manual signs during their basic education. As McVilly (1997, p. 21) reported, support staff members are usually very aware of their lack of training in AAC techniques, and suggest that they require a better preparation in this area themselves:

"The findings of the current study suggest that the areas of training most in need of attention are those concerned with communication strategies, particularly augmentative communication involving the use of sign language and symbolic or pictorial communication strategies. While many staff considered communication to be an important issue most indicated they were poorly prepared."

It is clear that support workers are in need of better training and support concerning communication with their clients in general, and the use of AAC and KWS in particular. Because of their education and background, SLPs could play an important role in this training and coaching of support staff, as we already suggested in section 7.5. When no SLP is available in the residence or day care centre, support staff should be able to call upon a team of SLPs or other communication professionals that deliver nationwide communication coaching. Within each facility and within each team as well, a person in charge of communication should be appointed. A psychologist, support worker, or other professional should be able to fulfil this coordinating task. This would ensure a better communicative climate for both support staff and their clients.

The appointment of a person in charge of communication, could also positively influence **maintenance and application** issues regarding KWS. These issues seem mainly related to motivation and attitude problems in support staff. People may have negative thoughts and believes with regard to KWS (Bryen &

Joyce, 1986), such as: “signing is inferior to speech” (Powell, 1999) or “when I use manual signs, my client will never learn to speak” (Millar, Light, & Schlosser, 2006). By providing correct and easy to access information on KWS, these prejudices could possibly be dispelled. Koski et al. (2010) also suggested that communication training for support staff should not only address communicative behaviours, but also thinking habits of support staff. Some individuals might feel inhibited to use manual signs and might even experience shame. This lack of confidence to try out newly acquired communication skills has been reported in literature as well (Bartlett & Bunning, 1997). This could be related to the attitude and work ethos of support staff, and to the culture of the workplace (Reinders, 2010). The more people use KWS in a given environment for example, the more it is considered normal and the more people will start using it as well (Powell, 1999). Support staff members also need to be willing to engage in a specific relationship with their clients to achieve an optimal communication with them. In order to do this, Reinders (2010) describes that support staff needs to possess a tacit knowledge of their client and how to engage with him or her, besides possessing explicit skills that are trained in a communication training. This engagement can be related to the quality of interaction between support staff and their clients. The quality of an interaction refers not only to the use of effective communication, but to a sensitive responsiveness of support staff towards their clients as well (Damen et al., 2011). This sensitive responsiveness entails that support staff recognizes the communication attempts of their clients, that they correctly interpret them, and that they respond adequately to them. The quality of interaction between support staff and their adult clients with ID has often been found to be insufficient. Support staff has been found to show a preference for a directive communication style, in which they take much more initiatives, and use more questions, directives, and instructions compared with their clients. They also were found to limit the turn-taking opportunities and conversational topics introductions of their clients (Dobson et al., 2002; McConkey et al., 1999). Support staff members often view their role in a conversation as unequal to that of their clients, and have problems in showing sensitive responsiveness towards their clients (Bartlett & Bunning, 1997; McConkey et al., 1999; Sanhueza, Coombs, & Mozol, 2008). Studies show that the communication and interaction style of support staff affect the communication of their clients

(Bartlett & Bunning, 1997; Mirenda & Donnellan, 1986). Therefore, trying to effect the quality of interaction between support staff and adults with ID seems important. Communication interventions for support staff have been found to positively influence quality of interaction between staff and clients. Staff has been found to display a more responsive communication style (Dobson et al., 2002; Purcell et al., 2000), to show more confirmations of receiving the signals of their clients, more responses to their communicative initiatives, and more sharing of emotions (Damen et al., 2011). These communication interventions all made use of video feedback. Communication trainings for support staff are further suggested to make use of conversation analysis and build upon existing skills of support staff (Bartlett & Bunning, 1997). Training should furthermore be interdisciplinary, and should not only address knowledge but also practice (Dobson et al., 2002). Purcell et al. (2000) suggested that support staff training should be work-based, client-focused, mentor-guided, and that effective communication strategies should be documented and shared. The aim of a communication training for support staff should be to attain a facilitative interaction style. Support staff should allow the client to control and initiate conversational topics, to take the lead in conversation, and to contribute to the conversation (Mirenda & Donnellan, 1986). The ideal method to train this interaction style of support staff in relation to their use of KWS in particular and AAC in general, remains to be investigated.

7.7. Directions for future research

7.7.1. KWS system

One of the main outcomes of this research project, is our suggestion to adapt the Flemish KWS system SMOG to include signs that are taken from VGT. The implementation of this adaptation should be further studied. This could be done by for example teaching SMOG signs to a group of individuals with ID, and VGT signs to a matched group. Functional KWS use of the individuals with ID could then be compared between the two groups. A similar experiment could be carried out in groups of support workers and other professionals. The influence of different sign characteristics of these SMOG and VGT signs on the acquisition and use of the signs could be studied as well. This would reveal if, as we suggest, individuals with ID and their support staff would indeed be capable of learning to use VGT signs functionally in a KWS approach.

Changing the manual signs used in Flanders to those of VGT, would also change the Flemish KWS system from having a restricted vocabulary to possessing a quasi-limitless vocabulary. Lacks in the vocabulary of current SMOG users could be identified and the basic lexicon could be re-evaluated formally. We know from the authors of SMOG that many new signs have been requested since the first persons with ID started using SMOG in the 1980s, but it is unclear how many signs, and which signs have been requested most. By questioning children and adults with ID and their parents and support staff themselves, an inventory could be made of the manual signs that seem to be most needful. This information could be used to develop VGT resources specifically for individuals with ID who use KWS. These resources could for example contain of a website with video clips and books with photographs. Vocabulary sets could be developed, aimed at different target groups (for example especially for adults) and treating different areas of fringe vocabulary. This could possibly happen in cooperation with the *Vlaamse Gebarentaalcentrum* (Centre for Flemish Sign Language), making use of their expertise and thus also reaching a larger target group.

7.7.2. Evaluation methods for KWS use

In this research project, a narrative task for the evaluation of the functional use of KWS in adults with ID was developed. The task was evaluated in a group of 40 KWS users and used in the intervention study in 15 adults with ID. This task seems a useful and valid method to evaluate functional KWS use in adults with ID, but should be evaluated more thoroughly. The psychometric reliability, in particular, should be explored. Test-retest and intra-rater reliability should be evaluated in a larger group of participants. Also, normative data could be gathered. Possibly, this narrative task could be adapted for use in children with ID and adults and children with other disabilities as well. Also, the functional use of other means of AAC could possibly be evaluated using a similar narrative task.

7.7.3. The use of KWS in adults with ID

We studied the functional KWS use of a group of 40 adults with ID, and the acquisition and use of KWS in a group of 15 adults with ID. These participants mainly had a moderate to severe ID. A first suggestion would be to repeat this study in a larger group of individuals. The intervention study in particular should be repeated to include more participants. Our survey study demonstrated that adults with profound ID, too, are able to learn small sets of manual signs and use them in functional communication. The precise method that is utilized by these clients, however, has not been addressed in our research project, because we only included adults with a manual sign vocabulary of more than 10 signs in the subsequent observation and intervention studies. It would be very interesting to examine the functional KWS use of adults with profound ID, who only possess a very small sign vocabulary, and to study the communicative functions that they can convey using a manual sign. Also, participants with other characteristics could be included, for example children with ID, adults and children with autism spectrum disorders, and individuals with other communication impairments.

In the intervention study, we only included measures of length and of semantic diversity to evaluate the functional KWS use of our participants. We did not take into account the exact communicative functions they used. Studying these in more details, would learn us if adults who learn KWS are capable of using a greater variety of communicative functions after a KWS intervention. We also evaluated the KWS intervention by measuring the KWS use of the participants only at two instances, before and after the intervention. The acquisition of KWS could be studied in more detail using multiple interval measures, for example every four months, in order to get a better idea of the course of this KWS acquisition and the influence of different client characteristics on KWS use during different stages of acquisition. The long-term effects of the KWS intervention should be evaluated as well, for example by measuring the functional KWS use of the participants 24 months or longer after the start of the intervention.

We tried to give an account of the functional KWS use of our participants using a narrative task and by evaluating their KWS use during conversation. These situations lean closely to everyday communication, but still are quite artificial. It could still be possible that participants are able to use KWS in a narrative task or during a one-on-one conversation, but have problems applying this skill in everyday life. This everyday use of KWS could be studied in an observation study, by observing a group of adult KWS users in their natural environment. Observers would have to invest a lot of time being present in the living environment of the adults with ID, for them to get adjusted to their presence. Also, observers would have to collect large amounts of data to cover many different communicative situations and opportunities for the participants to express different communicative functions. Therefore, this study design would only be feasible in a small group of participants. On the other hand, it would provide valuable information concerning the functional use of KWS in adults with ID within their everyday environment.

A next suggestion would be to study the KWS vocabulary that was used by our participants in more detail. We did include measures of semantic diversity (number of different words and signs used) in our study, but did not examine the KWS vocabulary that was used qualitatively. It would be interesting to explore which signs were predominantly used, and this information could also be related to the development of vocabulary sets and resources for adults with ID (see section 7.7.1). Also, the phonological quality of the signs that were used by our participants could be studied in greater detail. We considered manual signs as correct when at least two out of the three main phonological characteristics (hand shape, movement, and location) were present. It would be interesting to evaluate the quality of the manual signs in more detail, and to explore which phonological mistakes are mostly produced and, more importantly, when these errors start influencing sign comprehension negatively.

Our main focus was the manual sign use of our participants with regard to their functional use of KWS, although we also evaluated their verbal language. Because the verbal language of the participating KWS users was very diverse, future research could evaluate these differences and their relation with manual sign use in more detail. We did address this issue briefly by comparing the verbal utterances of our intervention group before and after the introduction of KWS, and found indications that the use of KWS also stimulated the use of verbal language in our participants. However, this should be studied in a more rigorous study design with a control group. Also, we do not know to which extent our participants were (or were not) intelligible without the use of KWS. We could not prohibit them to use KWS, but this could be evaluated by rating the speech they produced by blinded raters (similar to the study of Powell & Clibbens, 1994). The other aspects of KWS use, for example the use of body signals and the application of directionality or the use of classifiers (see section 1.3.1) could also be studied in more detail. Finally, this research project mainly focused on the use of KWS as support for expressive communication. In the intervention study, we did briefly address KWS as an aid in receptive communication as well. This receptive use of KWS should be studied in more detail and in various settings and applications.

7.7.4. KWS training of support staff

KWS use by support staff often seemed to be inadequate in this research project, although they did seem capable of learning to use KWS functionally after a 12-month introduction. With regard to this sign acquisition, we would suggest teaching a larger vocabulary to support staff. Different vocabulary sizes could be taught to different groups of support workers, and their capabilities in using KWS functionally in spontaneous conversation could be compared. Furthermore, maintenance and application of KWS in support staff should be studied in more detail. This is possibly related to their motivation and attitude. The influence of staff's attitude on the KWS use of their clients was apparent in this study. It would be worthwhile to further investigate the way staff attitude can be changed to a more positive one. Coaching of support staff by a team of SLPs or other communication professionals, could be a starting point. The quality of interaction between support staff and their clients should also be further investigated. Similar to what is mentioned in literature, we had the impression that the support workers in our research project often had a directive interaction style. This, of course, is a subjective impression we had, and should be further researched. The relationship between support staff and their clients and the quality of interaction, seems highly relevant to the functional communication possibilities of adults with ID. Methods to improve this quality of interaction should be explored, and the influence of such methods on the spontaneous conversations between staff and their clients should be examined. We hypothesize that the KWS use of clients would improve if their support workers would adopt a more facilitative communication style.

7.8. Conclusion

KWS is a means of AAC that is frequently used in adults with ID. Most literature available concerning KWS in this population, examines the acquisition and recall of small sets of signs in fairly unnatural situations. A lack of information concerning the functional use of KWS in adults with ID was present. Learning more about this KWS functionality and how it is influenced by different sign, client and environmental characteristics, was highly necessary. This research project attempted to contribute to this area of knowledge. Insight in the processes that are related to the functional use of KWS aids in a more purposeful and meaningful application of KWS in adults with ID. In achieving this improved application of KWS, we suggest the adaptation of the Flemish KWS system from a system with adapted signs and a restricted vocabulary, to a system that makes use of signs from VGT and with an open-ended vocabulary. We also propose making use of a narrative task to evaluate the functional KWS use in adults with ID, and caution not to use any prerequisites for adults with ID to be eligible for KWS or not. Finally, we found that a KWS training program which introduces KWS in a facility for adults with ID through their support staff, can be successful. Both support staff and adults with ID are capable of learning to use KWS functionally after 12 months of KWS introduction. Hopefully, these findings will improve the communicative competence of adults with ID who use or who could benefit from using KWS, and eventually contribute to an amelioration of their quality of life.

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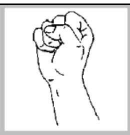
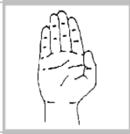
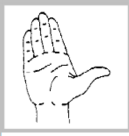
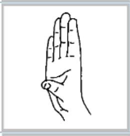
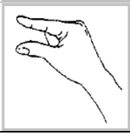
Appendix A (p. 1 of 3)

Overview of hand shapes in the *Spreken Met Ondersteuning van Gebaren* (SMOG) corpus, according to the phonological dependency model (Demey, 2005), HamNoSys (Hanke, 2004), and the American Sign Language (ASL) fingerspelling (drawings from Hanke, Zienert, Jeziorski, & Hanss, 2010).

DEM	HNS	ASL	
S	A1 A2 A3	A, thumb up, S	  
B	B1 B2 B5	flat hand	  
C	J1	C	
OB	J5	/	
bO+	K1	/	
T	K6	/	
bC	H1	G	
Q	H4	/	

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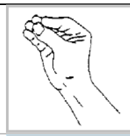
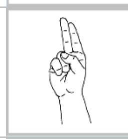
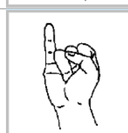
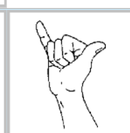
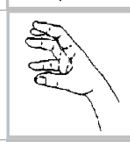
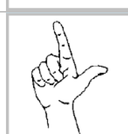
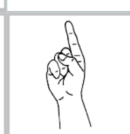
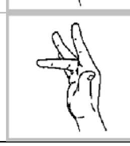
DEM	HNS	ASL	
O^	I4	/	
1"	C9	X	
H	D3 D6	H	 
2bO^	G14	/	
Y	C17 C18	J, Y	 
5"	F8	/	
B"	B7	/	
1	C2 C3	L, 1	 
8	F17	/	

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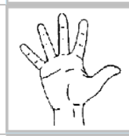
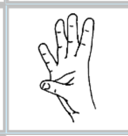
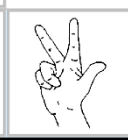
DEM	HNS	ASL	
O	I1 I7	O	 
5	F2 G2 M5	5	 
T+	G4	/	
bO	C7	T	
V”	E12	/	
V	E2 E3	V, W	 

Note. DEM = Demey (2005); HNS = HamNoSys (Hanke, 2004); ASL = American Sign Language

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The *Spreken Met Ondersteuning van Gebaren* (SMOG) corpus of 507 signs per semantic category; sign functionality scores per sign and per category (N = 119).

Animals (mean sign functionality score = 48.50)							
animal	38	cow	59	goat	38	pigeon	19
bear	36	dog	97	horse	90	rabbit	53
bird	63	donkey	31	lion	19	sheep	47
butterfly	35	duck	48	monkey	63	spider	29
cat	86	elephant	43	mouse	23		
chicken	85	fly	20	pig	45		
Clothes (55.88)							
bib	11	dress	100	pants	92	skirt	31
button	25	glasses	79	sanitary napkins	22	slipper	44
cap	77	glove	71	sew	61	sock	65
clothes	48	gown	31	shawl	68	sweater	55
coat	100	hat	34	shirt	52	umbrella	59
diaper	13	iron	68	shoe	62	undress	73
Conditions (29.39)							
black	33	easy	12	naughty	29	soft	11
blue	42	expensive	18	new	18	sour	11
brave	58	fast	27	noise	31	strong	31
brown	34	gladly	73	old	29	stupid	11
clean	13	green	31	pink	22	thick (one-handed)	48
closed	43	grey	21	pity	14	thick (two-handed)	48
dangerous	50	hard	10	poor	6	thin	12
different	12	heavy	13	pretty	66	very	5
difficult	15	hot (object)	63	purple	22	wet	21
dirty	57	lazy	6	red	50	white	34
dry	14	money	72	slow	23	yellow	34
Cooking and the kitchen (60.99)							
bottle	29	dry dishes	77	oven	31	spoon	73
clear	73	fork	82	plate	62	wash up	82
cook	19	fry	61	pot	15		
cup	63	knife	96	prepare food	90		
Feelings (52.92)							
afraid	73	cry	83	kiss	44	tired	33
angry	74	happy	57	laugh	32		
cheer	50	hot (person)	74	sweat	31		
cold	67	hunger	34	thirst	36		
Food and drinks (67.02)							
apple	101	coke	86	lettuce	43	roll	42
apple sauce	41	cookie	100	meat	99	salt	26
banana	89	drink	106	milk	105	sauce	71
beans	43	eat	108	nut	18	sausage	66
beer	82	egg (raw)	64	onion	34	soup	96
bread	100	egg (to cook/bake)	41	orange	91	spaghetti	101
butter	91	fish	87	pancake	91	strawberry	45
cake	96	flower	71	pea	35	sugar	55
candy	59	fries	109	pear	65	sugar cube	55
carrot	69	fruit	59	pepper	17	tea	65
cauliflower	30	grape	40	pineapple	32	tomato	60
celery	17	jam	88	plum	18	vegetables	61
cheese	101	kiwi	56	popsicle	106	waffle	66
cherry	30	leek	32	porridge	53	water	95
chocolate	84	lemon	37	potato	95	wine	49
coffee	108	lemonade	71	rice	58	yoghurt	80

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Functional words (30.46)							
and	5	forget	41	push	40	turn	18
ask	35	give	44	run	62	what	10
break	89	go	34	see	77	when	9
can	4	hang	40	should	9	where	12
carry	44	have	9	shout	20	which	4
catch	16	help	42	sit	60	who	12
come	47	how	4	stand	17	why	14
crawl	14	jump	36	take	33		
dare	2	know	28	talk	82		
fall	43	lose	24	throw	47		
Hobby and free time (47.08)							
ball	75	draw	50	newspaper	26	sing	77
balloon	50	Easter	36	paint	64	sing (microphone)	77
blocks	46	envelope	14	paper	39	slide	22
book	102	fair	18	party	96	soccer	42
build	15	fishing	26	paste	42	stamp	20
burn	24	gift	74	pay	65	swim	100
calculate	6	God	19	pen	44	swing	33
camera	79	gymnastics	63	picture	13	tape recorder	25
cd	38	hammer	32	play	56	tear	46
Christmas	57	holidays	81	pray	77	think	37
church	47	hug	51	puzzle	59	thread	11
cigarette	51	Jesus	31	read	22	toys	18
climb	22	knit	41	rest	30	visit	45
colour	21	learn	12	sand	17	walk	101
colouring	78	letter	29	save	9	wood	18
computer	45	make love	9	saw	48	work	99
dance (classic)	85	marry	39	scissors	90	write	71
dance (modern)	85	movie	61	shop	86		
doll	32	music	70	sign	45		
Nature (34.20)							
autumn	19	grow	14	mushroom	25	spring	18
dig	19	ice	24	plant	9	star	20
flower	16	leaf	14	rain	87	sun	63
garden	35	moon	18	sea	75	tree	76
grass	24	mountain	19	snow	69	wind	40
Persons and professions (37.13)							
baby	92	educator	33	man	27	principal	14
baker	30	farmer	17	mine	24	Santa-Claus	77
black Pete	66	fire brigade	21	mommy	80	sister	60
boy	44	friend	48	name	14	soldier	17
brother	50	girl	45	nun	12	teacher	11
butcher	14	gnome	10	nurse	52	we	24
children	51	hairdresser	82	person	1	witch	14
clown	28	he	23	police	34	woman	19
daddy	75	I	69	post	16	you	53
doctor	95	king	16	priest	15	your	12
Place indicators (24.88)							
after	19	here	43	next	15	there	49
between	10	in	22	on	28	under	22
corner	8	in front of	12	out	9	up	56
down	40	middle	10	outside	50	with	5
Politeness and obedience (49.32)							
beat	37	good	87	obey	10	tease	25
bravo	65	keep silent	85	please	46	thanks	57
bye	70	lie	5	quarrel	41	wait	78
don't touch	37	listen	71	sorry	28	yes	44
fight	30	no	61	stop	60		

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Quantities and measures (24.29)							
again	21	half	9	many	25	small (one-handed)	36
all	21	how many	9	more	7	small (two-handed)	36
alone	16	large (one-handed)	41	nothing	30		
enough	26	large (two-handed)	41	other	9		
group	31	little	32	same	23		
The body and being sick (55.89)							
bath	88	comb	101	operation	14	smell	43
beard	35	dead	66	pain	84	soap	60
bed	80	dream	13	pill	72	toilet	94
being born	17	handkerchief	43	poison	4	toothpaste	49
blanket	13	head	30	rise	48	towel	60
bleed	24	hearing aid	21	shave	66	vomit	49
blind	15	ill	93	shower	99	wash	95
blow	65	injection	70	sick	93	washcloth	39
brush teeth	107	menstruation	12	sleep	108	wheelchair	42
The house/home and related (42.69)							
apartment	12	heating	5	mirror	27	sponge	10
box	51	home	85	mop	39	stairs	31
candle	61	key	71	phone	99	sweep	59
chair	74	knock	55	pillow	17	table	71
clang	36	lamp	54	pour	45	tap	36
closet	51	letterbox	19	radio	56	television	91
door	66	machine	20	ring	36	wall	8
elevator	25	mat	11	room	29	window	16
Time indicators (39.44)							
always	6	first	20	morning	48	tomorrow	46
begin	10	Friday	64	noon	47	Tuesday	65
carnival	58	last	6	now	45	Wednesday	66
day	24	later	20	Saturday	65	week	13
done	73	long ago	11	Sunday	67	year	16
early	2	Monday	60	Thursday	65	yesterday	31
evening	58	month	8	time	71		
Traffic and vehicles (66.50)							
bicycle	104	bus	99	plane	63	train	73
boat	57	car	107	street	16	tram	13

Note. SMOG = *Spreken Met Ondersteuning van Gebaren* (Speaking with support of signs).

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Overview of the sign characteristics for the 507 basic *Spreken Met Ondersteuning van Gebaren* (SMOG) signs.

Part 1: Phonological characteristics (all categorical or binary variables)								
Parameter	**Categories**			**Analysis SMOG**				***N***
Location	Neutral space			43.79 %				491
	Head			22.81 %				
	Body			10.79 %				
	Hand			22.61 %				
Hand shape	Demey (2005)	HamNoSys (Hanke, 2004)	ASL / other	D (%)	ND (%)	DT (%)	NDT (%)	507
	No hands	No hands	No hands	.20	46.35	86.39	94.48	
	S	A1 A2 A3	A, thumb up, S	18.93	9.66	2.76	.99	
	B	B1 B2 B5	flat hand	24.46	24.65	.59	1.38	
	C	J1	C	6.11	2.17	.39	.20	
	OB	J5	/	1.18	.59	.00	.00	
	bO+	K1	/	.20	.20	.00	.00	
	T	K6	/	.20	.20	.00	.00	
	bC	H1	G	1.38	.59	.20	.00	
	Q	H4	/	1.18	.20	.00	.00	
	O^	I4	/	2.76	.79	2.56	.79	
	1"	C9	X	1.38	.00	.20	.00	
	H	D3 D6	H	3.35	1.78	.39	.00	
	2bO^	G14	/	.20	.00	.20	.00	
	Y	C17 C18 C19	J, Y	1.38	.20	.00	.00	
	5"	F8	/	2.76	1.78	.59	.59	
	B"	B7	/	3.75	1.78	.59	.20	
	1	C2 C3	L, 1	15.19	3.35	.99	.39	
	8	F17	/	.59	.00	.00	.20	
	O	I1 / I7	O	2.76	.79	.20	.00	
	5	F2 G2 M5	5	5.92	4.34	2.76	.39	
	T+	G4	/	1.38	.20	1.18	.39	
	bO	C7	T	.20	.00	.00	.00	
	V"	E12	/	.20	.00	.00	.00	
	V	E2 E3	V, W	4.34	.39	.00	.00	
Movement: direction	No movement			10.59 %				491
	Ipsi-contra			5.91 %				
	Contra-ipsi			8.55 %				
	High-low			16.90 %				
	Low-high			9.78 %				
	Close-far			14.87 %				
	Far-close			8.15 %				
	Combination			25.25 %				
Movement: shape	No movement			11.00 %				491
	Straight			46.03 %				
	Bow			26.48 %				
	Circle			11.20 %				
	+ shape			.20 %				
	Z shape			1.22 %				
	Combination			3.87 %				
Movement: hand-internal	No movement			85.13 %				491
	Open			2.24 %				
	Close			6.72 %				
	Round			2.24 %				
	Deround			.41 %				
	Spread			.20 %				
	Despread			.61 %				
	Wiggle			1.83 %				
	Rub			.61 %				

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Part 1: Phonological characteristics: continuation (all categorical or binary variables)			
Parameter	**Categories**	**Analysis SMOG**	***N***
Movement: crossing	No crossing of the midline	40.33 %	491
	Crossing of the midline	8.15 %	
	Production at the midline	51.53 %	
Orientation: static type *(= where does the movement start/end?)*	Neutral space	51.12 %	491
	Body start	5.70 %	
	Body end	4.68 %	
	Body start and end	1.43 %	
	Body continuous	12.42 %	
	Body middle	1.83 %	
	ND start	4.68 %	
	ND end	7.13 %	
	ND start and end	2.24 %	
	ND continuous	7.13 %	
	ND middle	1.63 %	
Orientation: static *(= which part of the hand defines the orientation of the movement?)*	No movement	10.59 %	491
	Ulnar	17.92 %	
	Palm	12.22 %	
	Back	11.00 %	
	Fingertips	12.63 %	
	Radial	7.94 %	
	Wrist	4.28 %	
	Combination	23.42 %	
Orientation: dynamic *(= does the orientation of the hand palm/fingers change?)*	No change of orientation	70.06 %	491
	Rotation	7.33 %	
	Pivotation	7.74 %	
	Nod	14.87 %	
Nonmanual expression	No nonmanual expression	90.34 %	507
	Nonmanual expression	9.66 %	
Contact	None	51.32 %	491
	Continuous (with movement)	11.41 %	
	Persistent (without movement)	8.15 %	
	End contact	10.39 %	
	Start contact	10.18 %	
	Double (start and end)	5.09 %	
	Grating (middle)	3.46 %	
Manuality and symmetry	Unilateral	46.23 %	491
	Bi Ba symmetrical	23.42 %	
	Bi Ba alternating	5.70 %	
	Bi Ba shadowing	1.43 %	
	Bi Ba synchronous	1.63 %	
	Bi UBa same hand shape	7.13 %	
	Bi UBa different hand shape, B	9.37 %	
	Bi UBa different hand shape, not B	5.09 %	
Repetition	No repetition of movement	58.86 %	491
	Repetition of movement	41.14 %	
Complexity	Not composed	96.84 %	507
	Composed	3.16 %	
Transition	No transition	89.00 %	491
	Transition	11.00 %	

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Part 2: Iconic characteristics (all continuous variables)			
Characteristic		**Analysis SMOG**	***N***
Transparency (percentage)		*M* = 22.45 % min 0, max 100 *SD* = 31.22	497
Translucency (percentage)		*M* = 54.477 min .80, max 100 *SD* = 26.613	497
Part 3: Referential characteristics (continuous and categorical variables)			
Characteristic	**Categories (if applicable)**	**Analysis SMOG**	***N***
Concreteness	(percentage)	*M* = 64.802 min 15.83, max 95.00 *SD* = 20.699	429
Grammatical class	Adjective	11.64 %	507
	Noun	54.83 %	
	Preposition	1.97 %	
	Pronoun	2.37 %	
	Verb	23.08 %	
	Other (adverb, conjunction, interjection, numeral)	6.11 %	
Semantic category	Animals	4.34 %	507
	Clothes	4.73 %	
	Conditions	8.68 %	
	Cooking and the kitchen	2.76 %	
	Feelings	2.56 %	
	Food and drinks	12.62 %	
	Functional words	7.30 %	
	Hobby and free time	14.60 %	
	Nature	3.94 %	
	Persons and professions	7.89 %	
	Place indicators	3.16 %	
	Politeness and obedience	3.75 %	
	Quantities and measures	3.35 %	
	The body and being sick	7.10 %	
	The house/home and related	6.31 %	
	Time indicators	5.33 %	
	Traffic and vehicles	1.58 %	

Note. D = dominant hand; ND = nondominant hand; DT = dominant hand after transition; NDT = nondominant hand after transition; Bi = bilateral; Ba = balanced; UBa = unbalanced.

Appendix D

Statistical analysis of sign characteristics related to sign functionality.

Continuous variables				
Variable	**Spearman's correlation coefficient *r***		***p***	***N***
Transparency	.282		< .001*	497
Translucency	.228		< .001*	497
Concreteness	.360		< .001*	429
Binary variables				
Variable	**Mann-Whitney U**		***p***	***N***
Nonmanual expression	10939.500		1.000	507
Repetition	24320.000		.066	491
Complexity	3054.000		1.000	507
Transition	11694.000		1.000	491
Categorical variables				
Variable	**Kruskal-Wallis χ^2**	***df***	***p***	***N***
Location	20.276	3	.003*	491
Hand shape dominant hand	23.473	23	1.000	507
Hand shape nondominant hand	21.871	18	1.000	507
Hand shape dominant hand after transition	9.070	14	1.000	507
Hand shape nondominant hand after transition	9.572	10	1.000	507
Movement: direction	19.137	7	.179	491
Movement: shape	9.283	6	1.000	491
Movement: hand-internal	5.774	8	1.000	491
Movement: crossing	4.491	2	1.000	491
Orientation: static type	18.827	10	.978	491
Orientation: static	18.771	7	.206	491
Orientation: dynamic	2.412	3	1.000	491
Contact	10.64	6	1.000	491
Manuality and symmetry	3.625	7	1.000	491
Grammatical class	39.942	5	< .001*	507
Semantic category	104.150	16	< .001*	507

* p < .05 (Bonferroni correction applied)

Appendix E

Narratives example.

P. nr.	U. nr.	Utterances V	Utterances M	Length of utterance V	Length of utterance M	SGC	SGS V	SGS M
1	1	Morning.	morning	1	1	setting	1	1
	2	Coffee.	coffee	1	1			
	3	(And) chair.	chair	1	1			
2	4	The (uhm) eggs.	egg	2	1	attempt	2	1
	5	(And) pouring milk.	pour	2	1			
3	6	In the oven.	oven	3	1			
4	7	(And) strawberries on the cake.	strawberry	4	1	direct consequence	2	1
	8	Cake.	cake	1	1			
5	9	(Uhm) pig birthday with the cake.	cake	5	1	setting	2	1
6	10	Pig talk to (uhm).	talk	3	1	setting	1	1
	11	Pig talk with the cake.	talk	5	1			
7	12	Eat the cake.	eat	3	1	attempt	2	1
	13	Pig birthday.		2	0	internal response	1	0
8	14	Bear asks pig eat cake.	ask, eat	5	2	internal response	2	1
9	15	Eat bear a cake.	eat	4	1	attempt	3	1
10	16	(And then) she is sleep.	sleep	3	1	setting	1	1
	17	In bed.	sleep	2	1			

Microstructural measures	V	M	Macrostructural measures	V	M
Number of words/signs	47	17	Recalculated setting score	4	3,2
Number of different words/signs	25	12	Recalculated initiating event score	0	0
MLU	2,76	1,00	Recalculated internal response score	4	1,33
TTR	0,53	0,71	Recalculated attempt score	5,6	2,4
			Recalculated direct consequence score	2,67	1,33
			Recalculated reaction score	0	0
			Total SGS	16,27	8,26

Note. P. nr. = picture number, U. nr. = utterance number, V = verbal language, M = manual signs, SGC = story grammar component, SGS = story grammar score, MLU = mean length of utterance, TTR = type token ratio

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Narrative task overview.

Picture	Utterance	Utterance Dutch*	Utterance translation	Story grammar component	Number of words	Number of signs
1.	1.	’s morgens zit varken in haar stoel.	in the morning, pig sits in her chair.	setting	7	3
	2.	ze drinkt koffie.	she drinks coffee.		3	1
	3.	plots denkt ze: “vandaag is de verjaardag van beer!	suddenly she thinks: “today it’s bears birthday!	initiating event	9	3
	4.	ik ga een taart voor hem bakken!”	I will bake him a cake!”	internal response	7	1
2.	5.	varken pakt bloem, melk, suiker en eieren.	pig takes flour, milk, sugar, and eggs.	attempt	7	4
	6.	ze doet alles in een kom.	she puts everything in a bowl.		6	1
	7.	ze roert het door elkaar.	she stirs it.		5	1
3.	8.	ze giet het deeg in de bakvorm.	she pours the dough in the baking tin.		7	2
	9.	die zet ze in de oven.	she puts it in the oven.		6	1
4.	10.	als de taart klaar is, haalt varken hem uit de oven.	when the cake is ready, pig takes it out of the oven.	direct consequence	11	3
	11.	ze versiert hem met aardbeien.	she decorates it with strawberries.		5	1
5.	12.	daar is konijn.	there’s rabbit.	setting	3	1
	13.	“wat ruik ik hier?” zegt hij.	“what do I smell?” he says.		6	2
	14.	“een taart voor beer!” zegt varken.	“a cake for bear!” pig says.		6	2
	15.	“heb je wel geproefd of de taart lekker is?” zegt konijn.	“did you taste if the cake is good?” says rabbit.	initiating event	11	3
	16.	hij neemt een stuk van de taart.	he takes a piece of the cake.	attempt	7	3

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Picture	Utterance	Utterance Dutch*	Utterance translation	Story grammar component	Number of words	Number of signs
6.	17.	daar is eend.	there's duck.	setting	3	1
	18.	"wat zijn jullie aan het doen?" vraagt ze.	"what are you doing?" she asks.		8	1
	19.	"varken heeft een taart gebakken voor beer!"	"pig baked a cake for bear!"		7	3
	20.	"proef maar of je hem lekker vindt."	"taste if you like it."	initiating event	7	2
7.	21.	konijn en eend eten van de taart.	rabbit and duck eat the cake.	attempt	7	4
	22.	ze vinden het heel lekker!	they really like it!	reaction	5	1
	23.	varken wil ook proeven!	pig also wants to taste!	internal response	4	2
	24.	ze neemt ook een stuk taart.	she also takes a piece of cake.	attempt	6	3
8.	25.	daar komt beer.	there comes bear.	setting	3	1
	26.	oei, de taart is bijna op!	oh, the cake is almost gone!	direct consequence	6	2
	27.	gelukkig is er nog één stuk over.	luckily, one piece remains.		7	2
	28.	"mag ik ook een stuk taart?" vraagt beer.	"can I also have a piece of cake?" asks bear.	internal response	8	3
	29.	"natuurlijk, de taart is voor je verjaardag!" zegt varken.	"of course, the cake is for your birthday!" says pig.	initiating event	9	3
9.	30.	beer is heel blij.	bear is very happy.	reaction	4	2
	31.	hij eet van de taart.	he eats the cake.	attempt	5	2
	32.	het is de lekkerste taart die hij al heeft gegeten!	it's the best cake he ever ate!	reaction	10	2
10.	33.	's avonds ligt beer in zijn bed.	in the evening, bear is in his bed.	setting	7	3
	34.	hij is moe, maar ook heel blij!	he is tired, but also very happy.	reaction	7	2
	35.	het was een heel leuke verjaardag!	this was a very nice birthday!	direct consequence	6	2

Note. * underlined words were accompanied by a manual sign

Appendix G

Case information for participating adults with ID (N = 15)

Nr	Case information
1	Client 1 was a woman with a severe ID who had severe difficulties both with receptive and expressive language. KWS was chosen as a means of AAC because she showed interest in manual signs.
2	Client 2 was a man with a severe ID and severe articulation problems. He also had problems with both receptive and expressive language. Because he responded enthusiastically to the use of manual signs, KWS was introduced to him.
3	Client 3 was a woman with a severe ID who had mainly difficulties expressing herself, although her receptive language level also caused communication problems. She already produced a number of manual signs, therefore KWS was chosen as a means of AAC.
4	Client 4 was a woman with a severe ID and severe articulation problems, combined with both expressive and receptive language difficulties. She responded very well to the use of manual signs, so KWS was chosen as a means of AAC.
5	Client 5 was a man with a severe ID and expressive communication problems due to poor articulation and word finding difficulties. He responded enthusiastically to the use of manual signs and thus KWS was chosen as a means of AAC.
6	Client 6 was a woman with a severe ID who had mainly expressive communication problems, related to articulation and word finding difficulties. She agreed to try out KWS, although she was not very keen about it.
7	Client 7 was a man with a moderate ID who had problems with both receptive and expressive communication. His articulation problems contributed to frequent communication breakdowns as well. Because he responded well to the use of manual signs, KWS was introduced to him.
8	Client 8 was a man with a moderate ID with both expressive and receptive communication problems. He had severe word finding problems combined with a poor articulation. KWS was suggested because he did not respond well to the use of visualizations.
9	Client 9 was a man with a moderate ID, severe articulation problems and frequent word finding difficulties. He agreed to attempt KWS to support his expressive communication, but was not very keen about it.
10	Client 10 was a man with a moderate ID who had little problems expressing himself verbally, but who had severe receptive vocabulary problems. KWS was chosen as a means of AAC mainly for language reception.
11	Client 11 was a man with a mild ID who wanted to learn KWS mainly to be able to communicate with Client 15, one of his closest friends.
12	Client 12 was a woman with a mild ID who mainly had problems with receptive communication. KWS was chosen as a means of AAC because she showed interest in the use of manual signs.
13	Client 13 was a woman with a mild ID who wanted to learn KWS mainly to be able to communicate with Client 15, who was a close friend of her.
14	Client 14 was a man with a mild ID who wanted to learn KWS mainly to be able to communicate with Clients 2, 4, and 8, who also lived in his living unit.
15	Client 15 was a man with a mild ID who was very poorly intelligible due to severe articulation problems. He also had difficulties with receptive language. Because he had learned manual signs when he was a child, KWS was opted for as a means of AAC.

Note: Nr = identification number; ID = intellectual disability; KWS = key word signing; AAC = augmentative and alternative communication

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Information concerning the KWS program

The development and pretesting of the key word signing (KWS) program that was used in this study, has been described in Meuris, Maes, and Zink (2012b) and Rombouts, Meuris, Maes, De Meyer, and Zink (2014). The program was developed for use in a residential and day care service for adults with mild to severe intellectual disability (ID), and consisted of four main components: training a group of support workers to become KWS ambassadors in four 2-hour workshops, introducing two signs per week to all support workers and clients (signs of the week approach), augmented input in which support workers modelled the use of KWS towards their clients, and a total immersion approach in which KWS was used on all relevant occasions in natural communication. The program was led by a speech-language pathologist (SLP) who was trained by the authors of the Flemish KWS system (see 2.1.) and who had more than 8 years of experience in using KWS.

1. Program components

1.1. Workshops

The first step of the program was to train eight staff members (one psychologist and seven support workers) as KWS ambassadors. Their task was to further implement the KWS program service wide. The KWS workshops were presented on the in-service training fair, and support staff voluntarily participated. We found the psychologist of the service, one person responsible for the day care program, and one to two for each residential group, willing to participate.

The workshops were developed with the behavioural skill training steps of Parsons, Rollyson, and Reid (2012) in mind. These authors suggested an evidence-based staff training protocol, which involves six essential training steps: (a) describing the target skill, (b) providing a written description of the skill, (c) demonstrating the skill, (d) requiring the trainee to practice the skill, (e) providing feedback, and (f) repeating practice and feedback until the skill is mastered. Parsons, Reid, and Green (1996) successfully used this protocol to teach manual signs to special education teachers. In an effort to increase generalization of the trained skills, they included role-play for skill demonstration and practice.

We developed four workshops which each lasted 2 hours. A basic corpus of 100 manual signs was taught to the participants (see 2.1.), first in isolation, then in sentences, and gradually transitioning to spontaneous communication. Techniques used throughout the workshops include verbal, written, photo, and video instructions (see 2.2. and 2.3.), modelling, role-play, practice, and verbal and video feedback (VFB). The rationale for choosing VFB as a method, came from literature concerning the positive influence of VFB on the teaching of motor skills (such as golf swings, Guadagnoli, Holcomb, & Davis, 2002; and arm and hand movements, Carroll & Bandura, 1982) and of VFB combined with practice on the teaching of communication skills (Mills & Pace, 1989). VFB has also successfully been used to train support staff in various skills, such as appropriate responses of support staff to challenging behaviour of adolescents with ID (Embregts, 2002). When developing the workshops, we pretested them in 49 student support workers. Sign knowledge of students who had received VFB combined with photo instructions was significantly better both on short (tested 1 week after the last workshop) and on long term (tested at a 6-month follow-up) compared to that of students who did not receive VFB and/or photo instructions.

In the first workshop, a 1-hour theoretical introduction to AAC and KWS was given. Both terms were defined, and a brief literature review on KWS was presented. KWS was described as an augmented input means of AAC, and the role of support staff in providing this augmented input was discussed. Possible advantages and disadvantages of KWS were mentioned, the basic principles of KWS were covered (e.g., using signs to support the key words in a sentence, always speaking while

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using manual signs, using a calm and clear communication style, using your dominant hand for one-handed signs, taking care of the correct hand shapes, movements, orientations, and locations, and so on), and examples of KWS use were given using role-play. Finally, the nature and purpose of the KWS program were presented. During the second hour of the workshop, verbal, written, and photo instructions for 50 of the 100 signs were given, they were modelled, and imitated by the participants. The participants were asked to practice these 50 signs at home.

In the second workshop, the remaining 50 signs were introduced similarly. The participants again were asked to practice these 50 signs at home. Next, the 50 signs that had been introduced in the previous workshop were practiced, first in isolation and then in sentences. The concepts of the 100 signs were printed onto 100 cards. First, the participants each time received one card and were asked to produce the sign for the concept on their card in isolation. They received verbal feedback, the teacher modelled the sign, and all participants jointly repeated. When the 50 signs were covered, each participant received two cards, and was asked to improvise a sentence using both concepts. Participants were filmed and could watch themselves on a screen for VFB. First, they had the chance to evaluate their own performance. Next, the teacher asked if the other participants had comments on the KWS use. Finally, the teacher provided verbal feedback and modelled the sentence, whereupon all participants jointly imitated. The participants were encouraged to give feedback to each other in a positive, constructive way.

The third workshop was similar. The 50 signs from the previous workshop were first practiced in isolation, and next in sentences with two signs per sentence. Next, each participant received six of the 100 cards and the signs were practiced in longer sentences / sentence combinations, using the same method (VFB combined with verbal feedback, modelling, and joint imitation). Hereafter, role-play was introduced. Participants were partnered up and received a theme, around which they improvised a conversation. These conversations again were filmed to provide VFB, combined with verbal feedback and, if necessary, modelling and imitation.

In the final workshop, the 100 signs were further practiced in role-play conversations. Participants were also asked to read a short story while using KWS. VFB and verbal feedback were continuously used. Additionally, the participants received information on methods that can be used to teach other people (colleagues or clients) manual signs. They were taught to use techniques such as modelling, moulding, shaping, and using verbal and physical prompts. These techniques were also practiced in role-play, using VFB and verbal feedback.

1.2. Signs of the week

After the workshops were finished, the psychologist of the service became responsible for the further course of the program, under close supervision of the SLP and in cooperation with the other seven KWS ambassadors. The further introduction of KWS in the service was lined out for the following 12 months, using a signs of the week approach. The order in which the signs would be introduced, was determined based on the frequency of use of the signs by a group of adult KWS users with ID (see 2.1.) and the interests of the participating adults with ID (in consultation with their support workers). The outlined order could be changed during the course of the 12 months if the need for certain signs would occur at an earlier point. The psychologist carefully registered which signs were introduced in the service at which time in a logbook (see Appendix J). The KWS ambassadors each week introduced two signs at the team meeting of the group staff, and at the client meeting. Visual reminders with photographs of the signs were displayed in the groups. The signs that already had been taught, were frequently refreshed during team meetings. By the end of the 12-month period, at a rate of two signs per week, the 100 signs that were taught to the KWS ambassadors, were introduced to all support staff and clients of the service.

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1.3. KWS modelling

All support workers were instructed to use KWS towards their clients with communication problems. The KWS ambassadors explained to their colleagues why KWS could help their clients with both receptive and expressive communication. At each point in time, support workers tried to use all manual signs that they had already been taught, whenever relevant in their natural interactions with their clients.

1.4. Total immersion

KWS was introduced to all support workers of all residential groups and of the day care centre. In each of the groups, at least one client experienced receptive and/or expressive communication problems which could possibly be supported by KWS. Support workers tried to ensure that these clients received a communication input rich in KWS. In this study, parents did not yet receive KWS training, but they did receive access to the photo and video instructions. In a later stage, they too were to receive a KWS training.

2. Material

2.1. Manual signs

The 100 signs that were used in this KWS program, were taken from the Flemish KWS system Spreken Met Ondersteuning van Gebaren (Speaking With Support of Signs, shortly SMOG; Loncke, Nijs, & Smet, 1998). Over 50% of Flemish services for adults with ID use SMOG with one or more of their clients (Meuris, Maes, & Zink, in press). SMOG consists of 507 manual signs. The 100 signs that were introduced during the first 12 months in which the program was active, were selected based on the results of a previous study (Meuris, Maes, & Zink, 2012a). In this study, a questionnaire was filled out for 119 adult KWS users with ID. This questionnaire, an adaptation of the Dutch version of the MacArthur CDI-scales (Zink & Lejaegere, 2002), registered which signs the KWS user produced during spontaneous communication. This resulted in a list of the 100 most frequently produced signs among Flemish adult KWS users with ID (see Appendix I).

2.2. Photo instructions

For these 100 signs, photo instructions were made. One or two photographs of an experienced SLP who put her hands in the right position(s) were taken. Movement and direction indicators (using arrows and lines) were added onto the photographs if necessary (see Figure H.1 for some examples). The photographs were joined in a booklet, supplemented with photographs of all hand shapes that were present in the corpus, and written instructions (hand shape, movement, direction, and orientation) for all signs. These booklets not only were used in the workshops, but were also distributed in the service for all support staff.

2.3. Video instructions

Video clips were made for the 100 manual signs as well. In these clips, an experienced SLP produced the signs, filmed frontally and from the side, in front of a blue background for optimal contrast (see Figure H.2 for an example). The clips were saved as mp4 files and were made available to all support staff by putting them on the internal server of the service, so that they could be consulted at any time. Video clips of the remaining 407 SMOG signs were also made available to the KWS ambassadors and support workers. This would ensure that the implementation of the KWS program could continue on after the initial 12 months that were the focus of this study.

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Figure H.1. Example photographs for the SMOG signs PARTY, HOUSE, and YEAR.

Figure H.2. Still frame from the video-clip for the SMOG sign COFFEE.

Appendix I

The 100 most frequently produced signs among Flemish adult key word signing users with intellectual disability.

1	coffee	35	bus	69	medication
2	ice cream	36	bread	70	to listen
3	milk	37	water	71	yoghurt
4	meat	38	jam	72	to cry
5	cookie	39	to swim	73	photograph
6	cheese	40	ill	74	ball
7	fries	41	to dance	75	to clear table
8	book	42	to shop	76	Sunday
9	to eat	43	toilet	77	cap
10	car	44	television	78	to sing
11	to sleep	45	pants	79	mama
12	apple	46	chicken	80	papa
13	to drink	47	banana	81	fork
14	spaghetti	48	cola	82	bed
15	cake	49	to wash up	83	bravo
16	to walk	50	to cook	84	to wait
17	to comb	51	broken	85	Saturday
18	to telephone	52	bath	86	to sew
19	dog	53	cat	87	sea
20	pancake	54	holidays	88	gift
21	to shower	55	doctor	89	warm
22	to bike	56	to talk	90	money
23	potato	57	scissors	91	lemonade
24	to wash	58	pain	92	tea
25	knife	59	beer	93	to undress
26	horse	60	to rain	94	key
27	fish	61	orange	95	to see
28	to brush teeth	62	to keep silent	96	Thursday
29	party	63	to colour	97	flower
30	to dress	64	to dry	98	Saint Nicholas
31	soup	65	glasses	99	spoon
32	to work	66	chocolate	100	Friday
33	baby	67	house		
34	butter	68	good		

Appendix J

Example of KWS logbook information

Date	Signs introduced	Signs rehearsed	Special activities	Remarks
March 1st	eat, drink	/	/	Generally, excitement and positive anticipation are noticed among support workers and clients with regard to the introduction of KWS that has now just started.
March 8th	coffee, milk	eat, drink	/	Management is very interested in the KWS introduction and has even contacted the local newspaper about this initiative.
March 15t	meat, cheese	eat, drink, coffee, milk	/	Support staff are still very enthusiastic. Some seem a bit shy to use the signs, but with some humour they do participate in group rehearsals.
March 22nd	ice cream, cookie	eat, drink, coffee, milk, meat, cheese	We listened to KWS songs	Music seems to work very well together with manual signs, the clients participate enthusiastically and try to sing and sign along.
March 29th	fries, spaghetti	eat, drink, coffee, milk, meat, cheese	KWS cooking activity	Clients enjoyed the cooking activity very much. Many of them spontaneously imitated the used signs. Support staff indicated that they enjoyed the fact that KWS could be introduced in such everyday activities as cooking, without much preparation or extra effort.
…				
June 14th	horse, fish	all food-related signs	We told a story supported with KWS	Support staff are very motivated to use KWS in different activities, such as story telling. Some of them are very creative at finding stories.
June 21st	wash, brush teeth	all bathroom related signs	KWS songs	Both clients and support staff respond very positive to the KWS songs.
June 28th	party, to dance	all food-related signs	KWS story	KWS ambassadors are recognized in their function by their colleagues and supported in their efforts to increase KWS use. Generally, much respect can be noticed towards the KWS ambassadors.

Appendix K

Instructions given to support staff for 5-minute conversation with their client (inspired by Abbeduto, Benson, Short, & Dolish, 1995).

• Try to encourage the client to communicate.

• Do not literally ask the client to use signs.

• Try to mainly ask open questions (e.g., “What happened then?”).

• Try to limit the use of yes-no questions.

• Try to follow the clients initiatives and interests.

• Only introduce a new topic when the previous one has been exhausted.

Possible topics

1. daily routine and activities in the residence / day care centre
2. support staff; parents, siblings and other family members
3. past or upcoming vacations, trips or special events
4. hobbies
5. favourite animals or favourite objects
6. friends, past or upcoming birthdays or parties
7. foods or drinks which are liked or disliked

Appendix L

Percentiles (10th to 100th) of the measures of content (story grammar scores), measures of length, and measures of semantic diversity on the narrative task for the 40 participants to the cross-sectional observation study.

	10th %ile	20th %ile	30th %ile	40th %ile	50th %ile	60th %ile	70th %ile	80th %ile	90th %ile	100th %ile
Measures of content										
VSGS	5,33	7,68	8,80	10,37	13,13	16,11	17,88	20,99	23,43	33,93
MSGS	0,72	2,28	4,10	5,45	6,23	6,56	7,13	7,93	8,67	9,53
Measures of length										
TUTT	11,00	14,00	16,40	20,00	22,00	25,40	30,00	32,60	37,10	47,00
VUTT	10,90	13,00	14,00	16,20	20,50	22,80	28,00	31,20	36,00	47,00
MUTT	1,00	4,80	8,70	10,00	13,00	14,40	18,00	19,20	24,20	38,00
SUTT	0,00	1,00	4,40	8,60	9,00	10,40	14,00	16,20	18,50	36,00
VWORD	15,80	18,80	24,00	38,00	48,50	54,80	70,30	77,20	96,10	139,00
MSIGN	1,00	4,80	10,40	12,20	14,00	17,40	21,00	21,20	26,60	43,00
MLU	1,38	1,46	1,53	1,68	1,85	2,27	2,91	3,41	3,77	5,36
MLST	1,00	1,00	1,00	1,00	1,10	1,11	1,16	1,23	1,35	2,43
Measures of semantic diversity										
VDIFF	8,00	10,00	14,00	17,60	24,50	28,20	35,60	41,40	48,10	70,00
MDIFF	1,00	2,80	5,00	6,60	8,50	10,40	12,00	13,00	15,00	24,00
VTTR	0,43	0,48	0,50	0,51	0,52	0,53	0,55	0,56	0,62	0,82
MTTR	0,42	0,49	0,56	0,57	0,61	0,64	0,74	0,82	1,00	1,00

Note. %ile = percentile; VSGS = verbal language story grammar score; MSGS = manual signing story grammar score; TUTT = total number of utterances; VUTT = number of verbal language utterances; MUTT = number of manual signing utterances; SUTT = number of simultaneous utterances; VWORD = number of words; MSIGN = number of signs; MLU = mean length of utterance; MLST = mean length of sign turn; VDIFF = number of different words; MDIFF = number of different manual signs; VTTR = type token ratio verbal language; MTTR = type token ratio manual signing.

List of publications

Publications in internationally reviewed academic journals

Meuris, K., Maes, B., De Meyer, A., & Zink, I. (2014). Manual signing in adults with intellectual disability: Influence of sign characteristics on functional sign vocabulary. *Journal of Speech, Language and Hearing Research, 57*, 990-1010.

Meuris, K., Maes, B., & Zink, I. (in press). Evaluation of language and communication skills in adult key word signing users with an intellectual disability: Advantages of a narrative task. *Research in Developmental Disabilities*.

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Meuris, K., Maes, B, & Zink, I. (submitted). Teaching adults with intellectual disability manual signs through their support staff: A key word signing program. Submitted to *American Journal of Speech-Language Pathology*.

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Meuris, K., Maes, B., Lembrechts, D., & Zink, I. (2009). Het gebruik van SMOG bij volwassenen met een verstandelijke beperking in Vlaanderen [The use of SMOG in adults with an intellectual disability]. VVL Congress. Antwerp, Belgium, 11 December 2009.

Curriculum Vitae

Kristien (Stien) Meuris was born in Lille, Belgium on December, 29th, 1982. She grew up in Beerse, and attended secondary school at the Sint-Jozefcollege in Turnhout, where she graduated in 2000 in Mathematics-Sciences. That summer, she headed for Norway where she enjoyed an exchange year abroad with AFS Intercultural Programs. In 2001, she started her Bachelor studies Speech Language Therapy at the Lessius Hogeschool (now Thomas More). She participated in the Erasmus exchange programme to Göteborg, Sweden, and graduated in 2004 with a Bachelor's thesis entitled "Value of the Boston Naming Test in Flemish children with a specific language impairment or an acquired brain injury." From 2004 to 2006, Stien worked as a speech-language pathologist in various facilities for children and adults with intellectual disabilities. In September 2006, she decided to continue her education in Speech Language Therapy and Audiology at the KU Leuven. She went on a scientific traineeship to Brisbane, Australia, and graduated in 2008. Her Master's thesis, for which she received the outstanding thesis award, was entitled "Treatment of drooling in amyotrophic lateral sclerosis". Since 2008, Stien works at the KU Leuven. She started as a teaching assistant in Speech Language Therapy and Audiology. In 2009 she became a research member of the Experimental Otorhinolaryngology (ExpORL) group under the supervision of Prof. Inge Zink (ExpORL) and Prof. Bea Maes (Parenting and Special Education). She is primarily interested in the use of augmentative and alternative communication in individuals with an intellectual disability.